THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 25. Thursday, February 16th, 1922. No. 287.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, o to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, AD ELPHI
LONDON, W.C.2.

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

Institution of British Foundrymen.

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Forthcoming Events.

Institution of British Foundrymen.

Falkirk Section.—"Malleable Cast Iron," by H. Williamson, on February 18.
Sheffield Branch.—"Cupola Facts, Factors and Fancies," by A. Poole. Joint meeting of the Derby and Sheffield Branches, and visits to some Sheffield works, on February 18.
Coventry Branch.—"Properties of Centrifugal Castings," by G. Williams, on February 22.
Institution of Production Engineers.—"Intensive Production of Automobile Bodies," by Mr. G. W. Eastwood, superintendent of the body building department of Arrol-Johnston, Limited, Dumfries, at the Institution of Mechanical Engineers, on February 24.
West of Scotland Iron and Steel Institute.—"The Work of Sorby and the Development of Metallography," by Professor C. H. Desch, on March 17.
—Annual general meeting, on April 27.

The Proposed Wedding Present for Princess Mary.

In our issue of February 2 we mooted the idea of offering to Princess Mary a wedding present which was to take the form of a casting made from one of the more common alloys. We suggested, if possible, two should be offered, one being of artistic merit and the other of domestic utility. The rules which were formulated were as follows:—

Rules to be followed.

(1) The casting to be either of domestic utility or ornament.

(2) To be sand-moulded from cast iron, steel, bronze, brass or aluminium, and to weigh not more than 10 lbs., except in the case of aluminium, where it is limited to 5 lbs.

(3) Machining to be kept down to a minimum.

(4) Lacquering, coating, or treating the surface by any process other than polishing, is not allowed before inspection by the committee.

(5) Firms or individuals may submit samples, but in the case of the former the names of all the employés who have taken part in its production must be given.

(6) A short descriptive note should accompany each sample.

(7) A selection of the castings submitted will be exhibited at the International Foundry Trades' Exhibition on THE FOUNDRY TRADE JOURNAL'S stand.

(8) The casting will be judged by a committee representing both art and foundry skill.

(9) Samples should reach this office before February 27, being sent by registered post or delivered by hand. A receipt will be given for each, and after the exhibition the castings will be returned to the senders, except those selected by the Committee as being suitable for offering to Her Royal Highness.

(10) To the casting there will be affixed a suitable inscription.

The scheme has been enthusiastically received by the trade, and we are pleased to announce that Mr. Oliver Stubbs, President of the Institution of British Foundrymen, intends asking the General Council to lend the scheme its patronage, and no doubt some of its members will be represented on the committee which will be appointed to judge the merits of the samples submitted.

Mr. Stubbs suggests that all Branch secretaries should place the matter before their Councils, as it is obviously highly desirable that whatever is offered should be the best that can be turned out by the whole British foundry industry.

Institution of British Foundrymen.

We would draw the attention of our readers to the change of address of the general office of the Institution, which is now situated at 38, Victoria Street, London, S.W. The telephone number is Victoria 6217.

There are for disposal a number of volumes of the Proceedings available for 1916-17, which can be obtained by members on payment of the postage. Additionally a few copies of the Proceedings for the current year are still obtainable at 6s. per copy.

XUM

A New Foundry Floor-Dressing Machine.

The line drawing and illustration which we give below show details of a small and compact machine for the turning over of the sand of the foundry floor after the boxes and castings have been removed. The apparatus has been designed and patented by Messrs. Ritchie, Hart & Company, Limited, of Mountpottinger Foundry, Belfast, who are themselves marketing the machine.

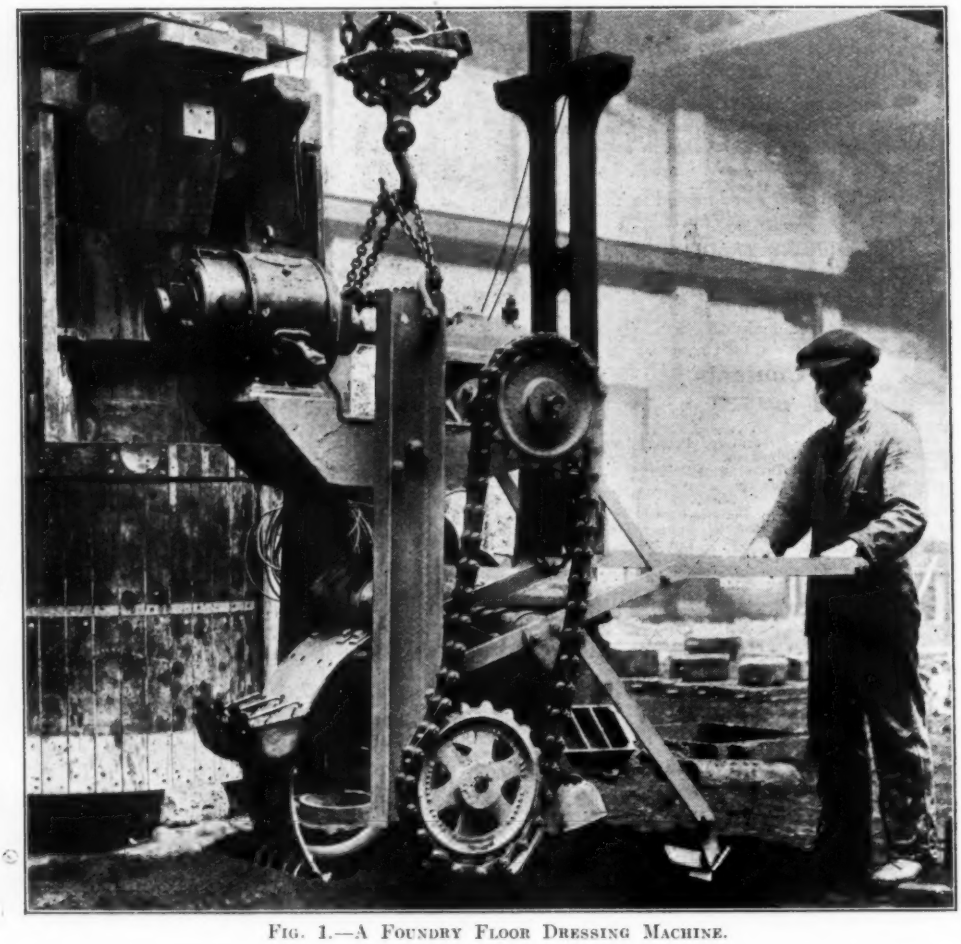

FIG. 1.—A FOUNDRY FLOOR DRESSING MACHINE.

As will be noticed from the photograph the machine is suspended from the crane, the operating current being taken from a convenient source. Two men are necessary for its operation, the one to drive the crane and the other to guide the machine.

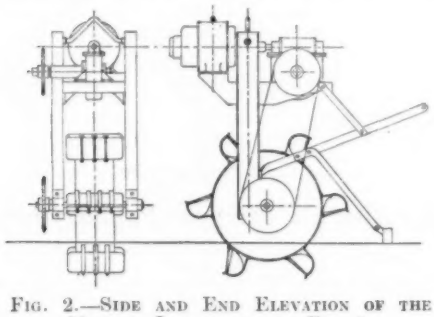

FIG. 2.—SIDE AND END ELEVATION OF THE MACHINE ILLUSTRATED IN FIG. 1.

The machine is entirely self-contained, and is driven by a 3-h.p. motor through worm gearing, both of which are rendered dust-proof. A chain and sprocket wheels are employed to transmit the power to buckets below.

The "dresser" proper, consists of a pulley, to the rim of which there are bolted a number of buckets. The buckets are provided with prongs for the purpose of breaking up the sand, which is completely mixed and thrown behind the machine. A scraper or leveller is also attached for the purpose of leaving the surface of the mould ready for the moulder. A practical result of its use in the works of the patentees is that much labourers' overtime, previously spent in turning over the floor after boxes have been removed, has been eliminated. The machine has every appearance of being a distinct labour-saving device.

Lectures on Foundry Practice.

The Department of Applied Science of the University of Sheffield has arranged a special course of eight lectures to moulders, pattern-makers, fettlers and engineers on foundry practice. The syllabus includes eight weekly lectures, which are set out below:—Green sand, dry sand, and loam moulds for iron, steel and brass; cast iron in the foundry; steel in the foundry; bronze and brass in the foundry, feeding, contraction and warping, wasters; by Dr. P. Longmuir, M.B.E.; malleable cast iron in the foundry, by Dr. W. H. Hatfield; and the University and the foundry, by Prof. C. H. Desch, D.Sc.

Written questions are invited after each lecture, and will be dealt with as far as possible in the following lecture.

No number of lectures can possibly give to the worker the knowledge and skill which are his by virtue of his daily toil. On the other hand, certain aids can be given which directly help to bridge difficulties when met with. They may also explain how and why certain results are effected in the course of his work.

Brussels Commercial Fair.—The third Brussels Commercial Fair is to be held from April 3 to 19, 1922, both days inclusive. The address of the Committee of the Fair is Maison des Ducs, 19, Grand Place, Brussels, Belgium. Telegrams: Foire Commerciale, Bruxellea.

Sand Blasting.*

By E. L. Samson.

Probably all foundrymen agree that the fettling shop is one of the most unpleasant spots to be met in the foundry. In some cases attempts have been made to improve conditions, but one of the chief remedies is still wanting in most foundries, *i.e.*, a properly designed sand blast equipment and dust-exhausting arrangement. It is strange that sanitary factory inspectors are not giving this keener attention and insisting upon sand-blasting preceding final fettling operations. A properly sand-blasted casting, however complicated the cores, should be quite free from caked sand and powdery surfaces, allowing the final fettling operation, such as chipping and grinding, to be done without raising clouds of dust, adding to the practically unavoidable trouble of metal dust arising from the grinding operation. But from a purely commercial point also, sand-blasting pays, as shown by the following figures taken from actual practice:—

(1) To clean a machine frame 1 ton in weight, size 8 ft. by 12 ft. combination cored and straight work—
Hand cleaning ... ... 2 hours
Sand-blasting ... ... 30 minutes.
(2) Machine frame, 3 ft. by 4 ft., straight work—
Hand cleaning ... ... 30 minutes.
Sand-blasting ... ... 4 minutes.
(3) Mower frames, weight 75 lbs., 12-in. cores, 2 in. to 2½ in. diameter; three pieces—
Hand cleaning ... ... 1½ hours.
Sand blasting ... ... 9 minutes.
(4) Journal boxes, weight 60 lbs., 90 pieces—
Time required to rumble ... 2 hrs. 16 mins.
Time required to sand-blast 1½ hrs.

In addition to the actual tumbling time given, 1½ hours were lost in packing into mill and taking out, while with the sand-blast tumbling barrel this only took a few minutes.

High versus Low Pressure Plants.

Before describing plants such as manufactured in the U.S.A. in detail, where sand-blast equipments of the most various designs are used to meet special requirements, it is intended to give a few data of sand-blasting, especially with reference to high-pressure air plants as made in the U.S.A. compared with low-pressure plants. Most of the plants here are designed for air pressures from 12 lbs. to 30 lbs. per sq. in., while in the U.S.A. the majority of plants are using from 40 to 80 lbs., and even higher pressures. The reasons advanced for using low pressures, *i.e.*, wear and tear on plant and danger, have all been overcome by properly designed plant, and, as regards the plea that increased power is required, it has been satisfactorily shown that, while a more powerful compressor is needed, the actual cost to remove, say, 1 lb. of iron or steel is less in the high-pressure than in the low-pressure equipments. This also settles any theoretical argument on nozzle velocity.

The following are figures from a Paper presented to the American Society of Mechanical Engineers by Mr. W. T. Magruder, Professor of Mechanical Engineering to the Ohio State University. These are details of practical commercial tests made under the direction of Mr. Magruder. Some of the principal figures are shown in Table I.:—

TABLE I.—*Showing the Capacity of Sand-Blasting Machine when the Distance of Work Piece and Angle of Blast are Constant, and the Air Pressure Variable.*

Air pressure per sq. in.	lbs.	20	30	40	50	60	70
Angle of blast	deg.	45	45	45	45	45	45
Distance of nozzle ..	in.	8	8	8	8	8	8
Bore of nozzle	in.	5/16	5/16	5/16	5/16	5/16	5/16
Free air, per min.	Cub. ft.	28.21	30.53	34.09	38.73	42.51	45.40
Sand discharged per min.	lbs.	17.00	20.20	25.60	31.50	36.90	41.50
Sand consumed per min.	lbs.	1.93	2.46	4.60	6.35	9.40	12.20
Usable sand remaining, per min.	lbs.	15.10	17.70	21.00	25.20	27.50	29.30
Iron removed per min.	lbs.	0.00469	0.00601	0.00781	0.01094	0.01562	0.02031

These figures are of a very interesting character, in so far as the actual air consumption is concerned, as compared with provision usually made in practice. Taking a 5-16 in. nozzle, Table II shows the approximate flow of air under various pressures from orifices into the atmosphere in cubic feet of free air per minute.

It will therefore be noted that whilst in practice provision is usually made for 119 cub. ft. of free air at 70 lbs. pressure, in this test it was shown that the consumption of free air per min. for the same orifice and 70 lbs. pressure was only 45.40 cub. ft., while at 30 lbs. pressure it was 30.53 cub. ft. It appears, therefore, that the actual air consumption is less than usually provided for, but of course losses in transmission have to be considered. Yet, even if the standard practice figures are compared for high-pressure and low-pressure plants, the following is shown:—For a 30-lbs. air pressure sand-blast on a 5-16-in. nozzle, a compressor would be installed giving at least 62.89 cub. ft. of free air per min. and requiring, say, 6½ h.p. to drive. For a 70-lbs. pressure plant and a 5-16 in. nozzle, a compressor would be installed giving 119 cub. ft. of free air and consuming, say, 20 h.p.

TABLE II.—*Showing the Flow of Air from Nozzles in Cubic Feet of Free Air at Given Pressures and H P. of Single Stage Compressor at Sea Level.*

Bore of Nozzles.	Pressure in lbs.	20	30	40	50	60	70	80
5/16 in. ..	Cub. ft.	17.10	22.50	27.50	32.80	37.50	43.00	47.50
	H.P. ..	1.40	2.32	3.26	4.49	5.74	7.22	8.65
¼ in. ..	Cub. ft.	30.80	40.00	49.09	58.20	67.00	76.00	85.00
	H.P. ..	2.53	4.12	5.99	7.97	10.25	12.77	15.47
5/16 in. ..	Cub. ft.	48.17	62.89	76.70	90.70	105.00	119.00	133.00
	H.P. ..	3.95	6.48	9.36	12.43	16.07	20.00	24.00
⅜ in. ..	Cub. ft.	69.00	90.00	110.45	130.00	151.00	171.00	191.00
	H.P. ..	5.66	9.27	13.42	17.81	23.10	28.73	34.76
½ in. ..	Cub. ft.	123.00	161.00	196.35	232.00	268.00	304.00	340.00
	H.P. ..	10.09	16.58	23.91	31.78	41.00	51.07	61.88

Abrasive Power Considerations.

From this it will be noted that practically double the quantity of air is provided for in the high-pressure plant and nearly three times as much power is needed. But, if the abrasive capacity of the two plants is taken into consideration it is

* Paper read before the Institution of British Foundrymen London Branch), December 9, 1921.

shown that the 30-lb. pressure plant removes 0.00601 lbs. of iron per minute, while the 70-lbs. pressure plant removes 0.02031, *i.e.*, 3½ times as much as the former. The test, however, shows that the air consumption is 45 cub. ft. and 30 cub. ft. respectively, *i.e.*, the high-pressure plant requires only about 50 per cent. more air than that worked by 30 lbs., but does 3½ times as much

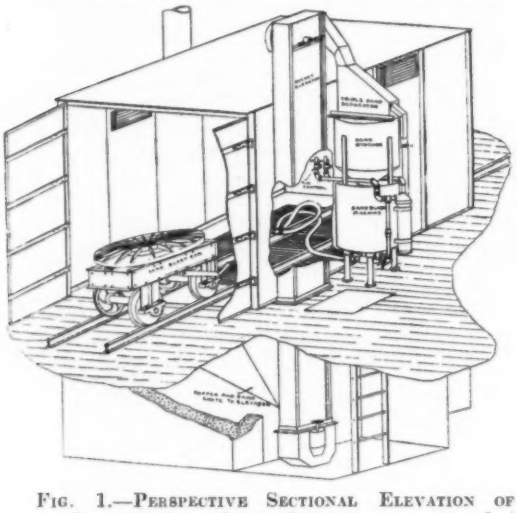

FIG. 1.—PERSPECTIVE SECTIONAL ELEVATION OF DOELCAM SAND BLAST INSTALLATION WITH CAR AND TRACK.

work, and for lower-pressures than 30 lbs. the comparison becomes still more favourable.

Here enters another factor, and that is the power required to drive the complete equipment, which includes the raising of the abrasive and dust collecting. The usual British practice is to raise the abrasive and dust above the dust collector, the heavy particles dropping into the sand-blast machine proper, whilst all the dust has to be handled by the exhaust fan. This means a great loss of power. Considerable economies can be effected by special dust-collecting chambers that are independent of the raising of the abrasive material. These will be described at a later stage.

The Cost of Sand Blasting.

It is calculated that with a ¼-*in.* nozzle, 100 lbs. of free air and 70 lbs. pressure a plant, complete

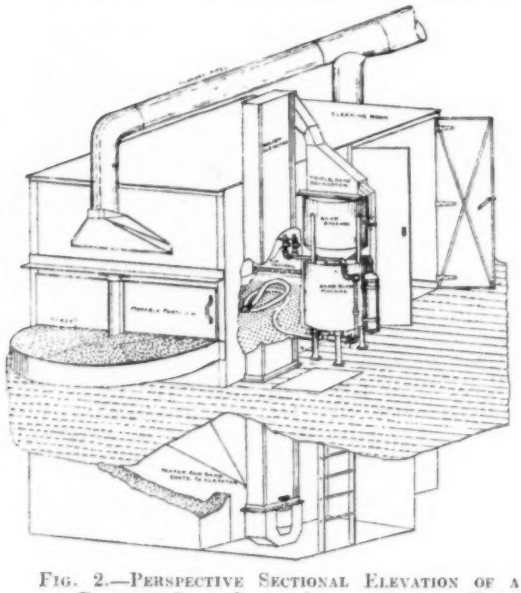

FIG. 2.—PERSPECTIVE SECTIONAL ELEVATION OF A DOELCAM SAND BLAST INSTALLATION OF ROOM WITH TABLE.

with dust collector and sand-elevating and screening, requires 25 h.p. to drive, and 10 to 15 tons of castings may be cleaned in eight hours. The cost of sand-blast plant, compressor and motor is roughly £1,500. Allowing three hours for bringing and removing the work to the table, about 100 units of power would be used in five hours, which, at the high figure of 3d. per unit, would mean:—

	£	s.	d.
Per day	1	5	0
One workman per day	0	12	0
One labourer per day	0	8	0
Sand and nozzles	1	3	0
Plant repair	0	2	0
Amortisation of plant in five years	1	0	0
Total	4	10	0

Based on 10 tons of castings this would mean 9s. per ton. The above figure for sand is based on the table figure showing actually used-up sand of

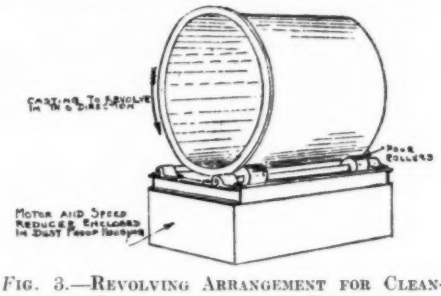

FIG. 3.—REVOLVING ARRANGEMENT FOR CLEANING CYLINDRICALLY-SHAPED CASTINGS.

about 1¼ tons in five hours. By using chilled-steel-shot instead of sand, the cost can be reduced and the output increased. With 30 lbs. pressure, British plants, requiring about the same horse-power owing to the exhaust fan swallowing up a great many units, the output would be nearer

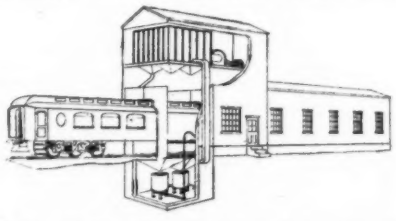

FIG. 4.—SPECIALLY-DESIGNED APPARATUS TO DEAL WITH RAILWAY CARRIAGES.

5 tons per day than 10, making the blasting cost double of what is stated above.

Modern sand-blast plants may be classified as follows:—Sand-blast rooms, cabinets, tumbling barrels, sanitary table equipments, conveyors.

Sand-Blast Rooms.

The sand-blast room is usually constructed of sheet steel, and the size to be adopted depends upon the class and size of work to be dealt with.

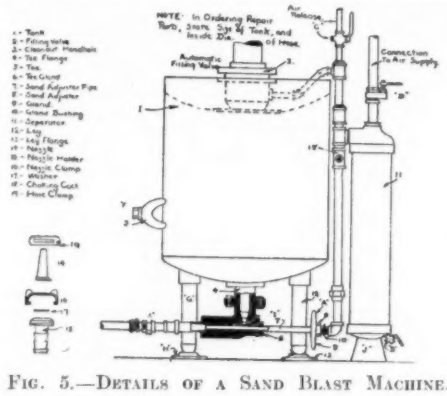

FIG. 5.—DETAILS OF A SAND BLAST MACHINE.

A great feature of the American plants is the handling of the abrasive material, sand or shot, as compared with British practice. Fig. 1 shows that the sand drops by gravity through perforations or grids in the floor of the sand-blast room into a hopper, which gravitates the sand or shot to an elevator. The abrasive material is elevated, drops on to a mechanically-

operated screen or sifter, all large particles (above a definite size screen) are removed on the top sieve, while the finest, and not usable, sand drops through the second screen, and the good sand flows back to a sand storage tank above the sand-blast machine proper.

This whole mechanical equipment is outside of the sand-blast room, and consumes only a small amount of power. The air control for the sand-blast machine is suitably arranged inside of the room. The air in the room is renewed by means of a fan, placed at the far side of the dust-collecting arrangement, *i.e.*, fresh air is drawn through openings in the sand-blast room. The dust is

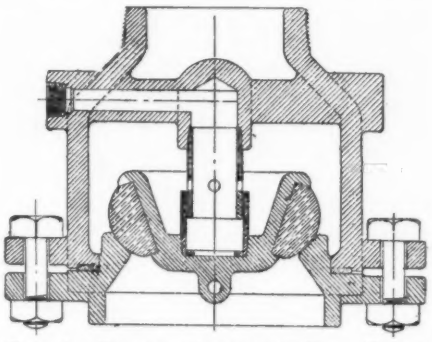

FIG. 6.—DOELCAM AUTOMATIC FEED VALVE.

drawn through the dust collector, so that the fan, if dust and air are properly separated, only handles pure air, which may be returned to the room if desired or blown into the atmosphere without any detriment to the surroundings. The actual dust-collecting arrangement will be described later on.

The air in the sand-blast rooms should be changed at least eight times per min., while most existing plants in this country are based on two to five changes per min., with the result that clouds of dust make vision practically impossible and fresh air must be supplied to the operator through a helmet to make his existence possible. Roughly speaking, a room 8 ft. long by 8 ft. high should be provided with an exhaust fan having a capacity of, say, 5,500 cub. ft. per min., at

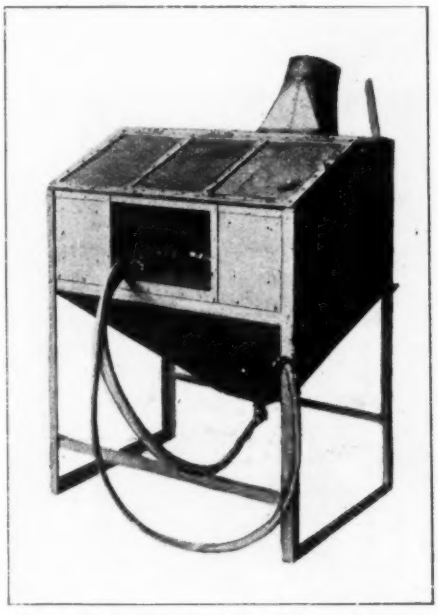

FIG. 7.—A TYPICAL SAND BLAST CABINET.

3 in. water gauge, special allowance being made in this figure as a result of practical experience, and this does not allow for the fan having to raise the abrasive. Any height above 8 ft. may be neglected when calculating the air volume required.

Dust nuisances in sand-blast rooms cannot, however, be entirely avoided but by fitting a revolving table at one end, half of which is always outside the room, the loading up can be done by a workman who is not affected by the sand-blast operation. Overhead runways, trucks or special mechanically-operated appliances are economical for bringing the castings to and fro and tilting the work pieces while the sand-blasting operation is in progress. A revolving table is shown in Fig. 2 and a tilting appliance in Fig. 3.

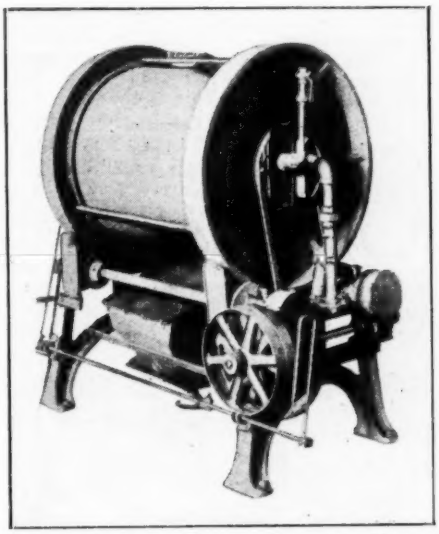

FIG. 8.—INJECTOR TYPE OF TUMBLING BARREL.

This has an internal motor in dust-proof base, the piece being revolved and tilted when required. Fig. 4 shows a large building specially designed for the cleaning of steel railway trucks.

Attention is here drawn to the simplicity of

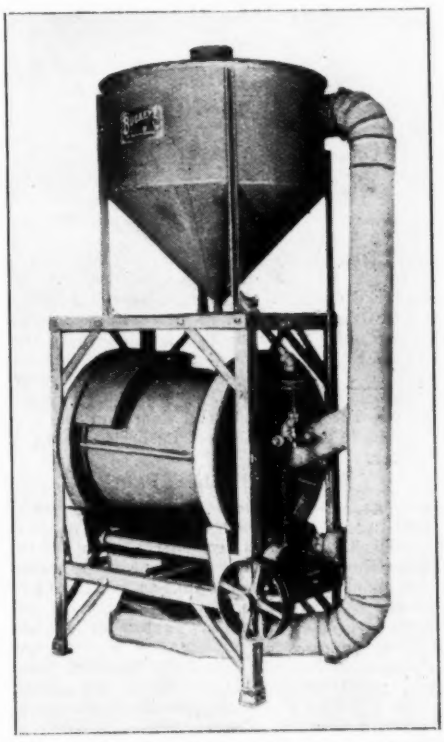

FIG. 9.—GRAVITY TYPE OF TUMBLING BARREL.

the positive sand-blast machine proper, used in connection with sand-blast rooms and some of the other equipments. In Fig. 5 it will be seen that the machine has no mixing valves of any description, as the sand drops through a tube (4), where it is met by the air at (7) and carried along, resulting in a very thorough mixture and high-nozzle velocity. The flow of sand is

adjusted by means of an adjustor handle (A), after which it requires no further attention.

A choking cock (18) is provided which, by means of a turn or two, will blow out wet sand or obstructions. It is very important, however, that a large-sized air receiver should be used near the sand-blast machine to take care of any moisture carried along in the air piping, as moist sand is very troublesome, and, unless good dry sand is obtainable, chilled steel shot is preferable for many purposes unless very fine surfaces are to be obtained. The sand-blast machines may be had with a circular valve at the top, which automatically closes as soon as the air pressure comes into action, *i.e.*, no further sand can drop from the sand storage tank. This is shown in Fig. 6.

Sand-Blast Cabinets.

A typical cabinet is shown in Fig. 7. Cabinets are largely used for small castings not requiring a very high abrasive action. The sand blast used is of the injector or suction type, *i.e.*, the sand-blast nozzle has a double hose line, the one being connected to the sand storage hopper below the cabinet, the other to the air line proper from the compressor. The air, rushing to the nozzle through the air-pipe line, sucks up the sand through the branch hose and then blasts the

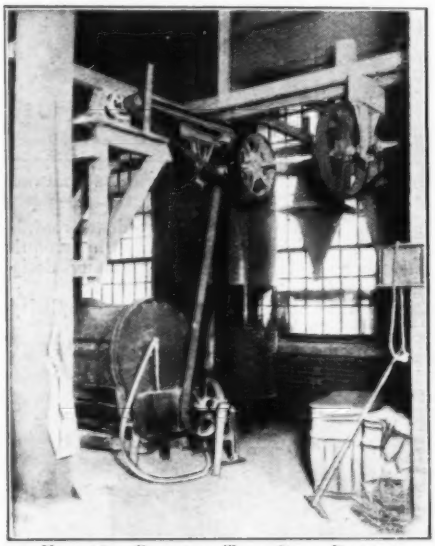

FIG. 10.—POSITIVE TYPE SAND BARREL.

mixture on to the casting. The sand is used over and over again, the dust being exhausted at the rear of the cabinet into a dust-collecting arrangement. No armholes are required in this cabinet, as the exhaust from the fan is sufficiently powerful to take away all the dust, but a rubber screen is provided to protect the operator against any rebounding sand. He can clearly view the operation through inspection doors on the top of the cabinet, powerful electric lights being provided for.

Sand-Blast Tumbling Barrels.

It is a fallacy to believe that water tumbling or rattling is a good medium for cleaning castings. The process is expensive, and actually hardens the surface, especially of brass castings, so that machining is made difficult instead of easy, as in the case of sand-blasted parts.

There are three standard types of sand-blast tumbling barrels used in the U.S.A., but special types or combinations have been supplied to meet special conditions. These barrels are classified as:—(a) Injector type; (b) gravity type; (c) positive type.

Injector Type.—This type as shown in Fig. 8 is similar to that described under sand-blast cabinets, *i.e.*, the sand is sucked up and blown through the nozzle by means of the air current from the compressor. This injector type is recommended chiefly for brass work not requiring strong abrasive action, but by having pressures of, say, 80 lbs. and up, this type barrel is used with the best results also on malleable iron castings.

Gravity Type Tumbling Barrel.—The principle of this type, which is illustrated in Fig. 9 is that the falling abrasive sand or chilled steel shot is met by the air current and carried to the nozzle. This gives a very good abrasive action and gravity feed-type machines are therefore suitable for practically any kind of work. The sand may be elevated by the same fan as is used for the dust exhaust, or the abrasive material is elevated by means of a bucket elevator

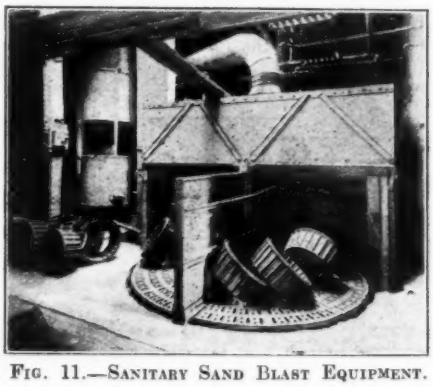

FIG. 11.—SANITARY SAND BLAST EQUIPMENT.

and dumped into a sand storage tank, from which it falls to the nozzle. The latter method is generally preferred.

Positive Type.—This type of sand-blast barrel, which is shown in Fig. 10, implies a separate sand-blast machine, as previously described, which, in combination with the sand-storage tank and bucket elevator, forms the most satisfactory installation that can possibly be obtained. It is specially suitable for steel castings, drop forgings, or malleable castings which are badly crusted. It also has the advantage that the hose can be detached and readily used for blasting large castings in an adjoining room or cabinet. In all the machines noted the actual screening of the sand is done below the barrel, *i.e.*, it is sifted and strained after use so that only good sand has to be raised again.

Sanitary Sand Blast Table Equipment.

This is the type of plant in which the operator stands right outside of the cabinet. These equipments are made with either hand-rotated tables, in which case the operator holds the nozzle and works it through a rubber curtain, as illustrated in Fig. 11, or with automatically-rotated tables

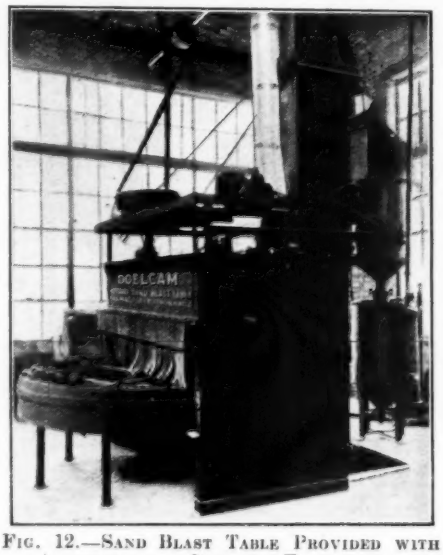

FIG. 12.—SAND BLAST TABLE PROVIDED WITH AUTOMATICALLY ROTATED TABLE AND OSCILLATING NOZZLES.

provided with oscillating nozzles, so that only a man is required for putting the castings on the table and removing them after they have passed under the nozzles. This equipment is shown in Fig. 12.

(To be continued.)

Witton Engineering Works, Birmingham.

THE GENERAL ELECTRIC COMPANY, LIMITED, invited members of the Press to visit their Witton Works on the 7th inst., that day being the twenty-first anniversary of the establishment of the works.

It was in February, 1901, that the first portion of the present works was laid down in what was then open country on the outskirts of Birmingham. In the early days the company concentrated upon the production of electrical apparatus for light engineering work. Of course, this was at a time when the country was not prepared to think in big electrical units; little if anything had been attempted by way of electrification in iron and steel works, and still less in collieries, and the plant to meet the then small demands for the most part came from abroad. Since those early days, however, the electrical operation of steel works has undergone a revolutionary change.

FIG. 1.—THE FOUNDRY, WITTON WORKS. GENERAL VIEW OF ONE OF THE MAIN BAYS.

It is only during the past few years that the G.E.C. have developed a heavy engineering section, and its development has been the outcome of experience gained by patient research work and practical experiments which have been carried out at the Witton Works for many years. The extensions at Witton comprise seven new buildings, which include switchgear works, standard motor works, development department, moulded insulation works, enamelling and plating works, administrative offices and club-house, whilst extensive additions have also been made to the foundry, main engineering works and the small motor works. These new shops and extensions to shops in themselves rather more than doubled the works capacity, but that capacity is enhanced very materially by the improvement effected in the general layout, the provision of liberal gangways in all departments, and the excellent transport facilities between the various departments. The works as we find them to-day are practically self-contained, and the company are in a position to manufacture the heaviest units commercially possible at the present time, and to design and construct the electrical machinery and control gear for the complete equipment for power stations and railways.

The works at Witton are linked with those of Messrs. Fraser and Chalmers, Erith, and this materially facilitates fulfilling large and complete contracts involving heavy engineering. To deal with the heavy engineering plant the main engineering works are divided into four extensive bays, and all classes of machines from 100 h.p. (or smaller machines if of a special nature) are here constructed, including turbo-generators, slow-speed generators, rotary converters, and motors for driving many varieties of industrial plant.

One of the bays is devoted exclusively to the construction of turbo-alternators. The stator castings are brought in at the east end, which is separated only by a road from the foundry. Here also the forgings are received; the rotors, it may be noted, are all forged solid. The end of the bay referred to has a full range of modern tools, many of them of special design for turning and milling the rotors and for boring and slotting operations on the stators. After machining, the stator cores are built up and lightly clamped in position, both stator and rotor now passing to the winding section of the bay, and subsequently to assembly test and despatch.

It may be noted that all turbo-alternators of 6,000 k.v.a. and upwards are provided with embedded temperature detectors. Of the units passing through at the time of our visit, special mention may be made of one for the Borough of Marylebone, rated at 10,000 k.v.a., to run at a speed of 3,000 r.p.m., and another, close by, rather larger, intended for the Bury Corporation, with an output of 12,500 k.v.a. at the same speed. Others to be noted were two of 6,000 k.v.a. for Guest, Keen & Nettlefold; one of 7,500 k.v.a. for Bolckow, Vaughan & Company and others of 6,000 k.v.a. for Darlington and Newport Corporations. The demand from the Colonies for this class of machine is increasing; three sets of 3,500 k.v.a., for instance, are being built by the G.E.C. for

the City of Pretoria, and three of rather greater capacity for the City of Auckland. Several other units with outputs of from 4,000 to 22,500 k.v.a. were for important British corporations, ironworks, cement works, collieries, etc. Most of the machines referred to are designed to run at a speed of 3,000 r.p.m. An order has just been secured from the Birmingham Corporation for a 25-cycle 22,500 k.v.a. set to run at 1,500 r.p.m. This machine, in common with nearly all those in the shop, is to be driven by a Fraser & Chalmers turbine.

Of the other bays of the main engineering works two are laid out with an extensive range of machine tools capable of dealing with heavy parts of large, slow-speed generators, rotary converters, motors, etc. The fourth bay is devoted to winding, special provision being made for impregnation, etc.

The G.E.C. rotary converter calls for a special mention, as it is a machine as mechanically robust as it is electrically sound in design. In view of the fact that there is an ever-growing demand for electrical converting apparatus, and that the rotary converter is, for many reasons (amongst which may be mentioned low initial cost, high efficiency and simplicity of operation), the most suitable form of apparatus, the G.E.C. rotary converter has undergone many important improvements in the last few years. It is very widely installed in power houses and sub-stations to-day, and some interesting examples of this class were seen at the works. One of 2,000 kw. was the last of four of this output to be supplied to the City of London Electric Lighting Company. Another order now going through the shops is for the Charing Cross and West End Company, this consisting of two 1,500- and two 1,000-kw. sets. The value of the G.E.C. rotary converter is much enhanced by the self-synchronising panel, which embodies many valuable patents held by the company, and which offers important advantages over other types of a similar apparatus, the operations being extremely simple and fool-proof.

Although the rotary converter is usually of standard design, a machine supplied to the British Mannesman Tube Company at Landore presents certain features of special interest. A current of 5,000 amps. was required from the D.C. side, thereby necessitating a double commutator. The machine has to supply Pilger mill and other types of steelworks motors, which form a very severe load, but the converter has given entire satisfaction in operation.

A large number of rolling-mill motors were to be seen in various stages of construction. Amongst those complete and awaiting test may be mentioned two D.C. machines of 1,000 and 500 h.p. respectively for Sheffield, where they will operate mills by direct drive. There was also to be seen the armature of a D.C. machine of 4,000 h.p. designed for driving a 26-in. reversing mill. Steelworks motors of both A.C. and D.C. types have been specially designed to meet the demands of the steelworks for a three-phase totally-enclosed motor capable of rapid dismantling.

The foundry, as already stated, lies at the eastern end of the main engineering works, and is the largest of its kind in the Midlands. It is covered by three bays, each being actually a self-contained foundry, with its complement of cupolas, moulding machines, etc., catering for a special class of work. In the one bay heavy castings can be made up to 50 tons in weight; of the other bays, one is devoted to the production of castings for fans and small motors and the third to medium castings. The moulding machine naturally is extensively used in the medium- and light-castings bays; the largest of the machines can deal with a box of a total weight of 10 tons.

Fig. 2.—A Machine Bay in the Standard Motor Works, Witton.

The switchgear department covers an area of 100,000 sq. ft., and in its layout it is an object lesson of careful forethought not only to facilitate efficiency and economical production, but also to provide the best possible working conditions for the men engaged upon the various processes. The building is bounded by a main road on two fronts. The stores extend down the centre of the building, so that handling of parts is reduced to a minimum, whilst the grouping of the benches and machines is such as to facilitate rapid progress of the work through the shops.

On one side of the stores are two main bays devoted to the erection of switchboards, starters and control gear respectively. The ironclad and

heavy switchgear is constructed on the opposite side of the stores, where a section is also set apart for machine tools. Arranged in series on this

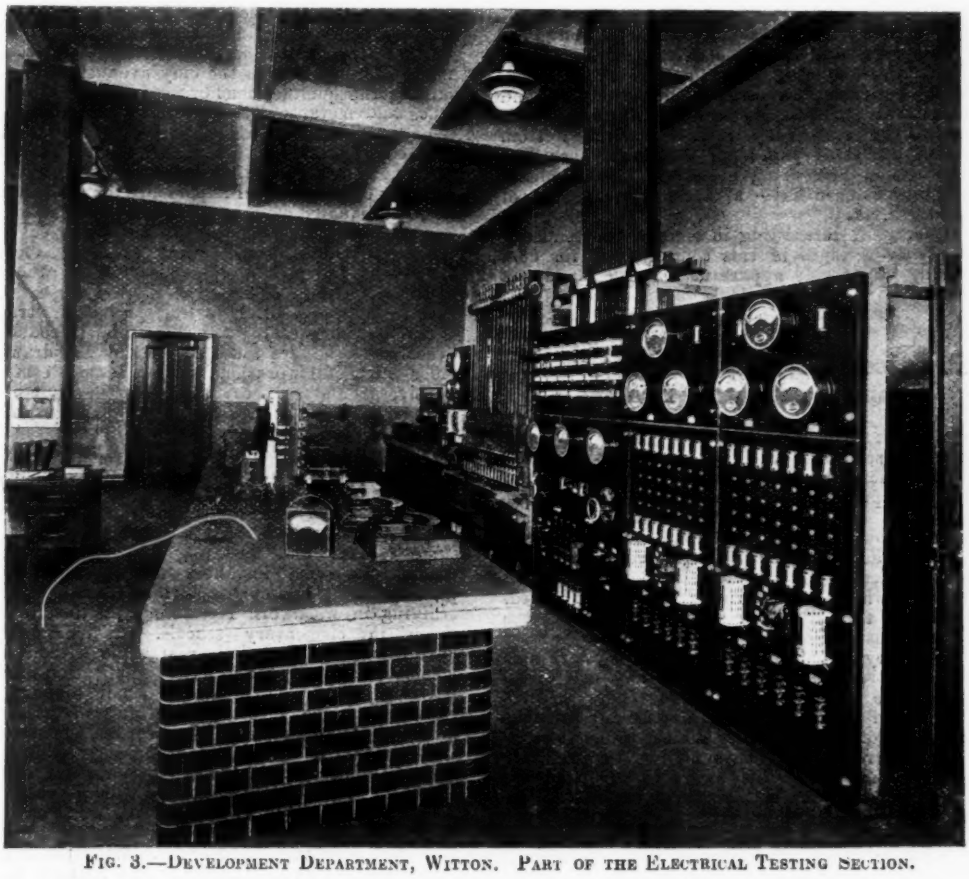

FIG. 3.—DEVELOPMENT DEPARTMENT, WITTON. PART OF THE ELECTRICAL TESTING SECTION.

side of the stores are also a number of shops, in each of which one of the various auxiliary processes—such as plating, enamelling, slate drilling,

FIG. 4.—PREPARATION FOR CASTING A 15,000 K.V.A. TURBO STATOR IN THE G.E.C. WITTON FOUNDRY.

and cementing—are carried out. These shops are exceptionally well lighted and ventilated. The test room runs across one end of the works at right-angles to the bays, whilst adjoining is the packing and despatch department.

Of the work passing through the shops, mention may be made of the main switchboard, drum controller, slip resistance controller, contactor panels, etc., to be supplied in connection with the D.C mill motors which were seen in the main engineering works. Perhaps the most important switchgear contract now being undertaken at Witton,

of which several items were on view in the shops, is for the complete equipment of a special switchgear house for the Metropolitan Railway.

The main section of the contract calls for 11,000-volt gear to control one 12,000-k.v.a. alternator, five 5,000-k.v.a. alternators, fifteen outgoing 300-amp. feeders, etc. The switchgear house will be in three storeys, with the bus-bar chambers on the top floor, oil switches in the middle, and instrument transformers below. All the switches are to be electrically remote controlled from special operating panels on the third floor, the high-tension gear being housed in brick cubicles. The oil switches have a breaking capacity of 350,000 k.v.a.

Other gear, interesting in view of the tendency to higher voltages in this country, was for controlling 33,000-volt apparatus for a company in Wales.

Practical Foundry Instruction in Junior Technical Schools.

In the main, the instruction given in junior technical schools is intended to fit boys for the many branches in the engineering industry. They are really preparatory schools for those who desire to become draughtsmen or artizans. They are advantageous in that they impart fundamental principles and at the same time create an atmosphere which assists in determining the particular craft for which any individual boy is best suited. It is in this direction particularly that the practical instruction is of vital importance, because it is only by actual practice that the boys are able to demonstrate their aptitude in any one direction. The old custom whereby boys became apprenticed to trades without having any previous knowledge of their capacity for the trade selected frequently resulted in boys having to persevere in trades for which they were totally unsuited, and in too many cases they never became skilled. The boys who take the special course provided are either scholarship boys or they have secured their position by competitive examination. With few exceptions only those who have a special inclination towards the technical trades take the course of instruction. It is, however, during the actual period of instruction that a more definite desire is exhibited. In some cases, of course, though the boys desire to take up some special trade or profession in engineering, or it may be that their parents are so desirous, they give little evidence of ever being likely to become successful in any which are dealt with in the course. Generally, however, the boys manifest a special aptitude in one direction, and, as a rule, all work which bears directly on that special occupation is a pleasure rather than a task. They display a keenness in certain branches of their work in contrast to that which is shown in others. It is this special inclination which is so helpful in determining the boys' future occupations. When the course of instruction is almost completed and the boys are looking forward to making a start on their future career, an effort is made in finding out just what branch of engineering each boy has decided to take up. In some cases the boys, no doubt with the aid of their parents, have little difficulty in finally deciding; while in others they are assisted in coming to a definite decision according to the capacity they have displayed in their preparatory work. Many school authorities do not confine themselves to giving of instruction, but are largely responsible for placing the boys in suitable positions. The works in the vicinity of these schools recognise the value of boys who have completed a course of special instruction, and, at the invitation of the school authorities, send a list of vacancies covering various departments which they desire filling if suitable boys are available.

While the method of training and the quality of instruction given may be open to much criticism, the principle of determining the suitability of a boy for a particular occupation is good. Quite apart from the advantage derived from the disposition of the boys to show a special inclination for one of the crafts in engineering, the very fact of having a little experience in others together with some idea of the guiding principles gives them a broader knowledge at the outset of their career, and to a certain extent they recognise the skill involved in other trades, and consequently have respect for craftsmen in other branches.

In the average junior technical school, however, the boys' outlook is limited, and it always will be, but its scope could be considerably widened. In many of these schools the only avenues for determining the qualifications of boys are the drawing office and metal workshops; there is thus a tendency for boys to express a desire for a craft covered by either of these two branches of which they have a certain knowledge, to the exclusion of other crafts of equal importance and demanding at least equally as much skill. It is these two sections in engineering that are overwhelmed with intelligent boys, while other sections have to lament on the poor intelligence of those who become apprentices outside the limited scope. The special aptitude of boys for particular trades would be more easily determined by introducing other crafts besides those covered by the drawing office and metal workshop, so that a more comprehensive groundwork would be covered, giving the boys better facilities for determining the trade for which they are best suited.

Considerable improvement can be made by introducing the practical instruction of patternmaking and foundry work. The writer is well aware that in some schools an attempt is being made to instruct in patternmaking without carrying it a stage farther and moulding from the patterns made. In some instances the instruction in patternmaking is simply a glorified form of manual training in woodwork resembling the instruction given in elementary schools. Instruction in patternmaking is of little real value without the means for showing the practical application of the patterns when completed. A small foundry is essential to the successful teaching of patternmaking in order that the various principles involved may be demonstrated and actually proved by the students themselves. Besides the value attached to the foundry as an aid to patternmaking instruction, both moulding and casting have their own special value, involving manipulative skill of a very high order. With the introduction of both patternmaking and foundry work in conjunction with machine drawing and metal workshops, the boys are able to form a better opinion of the relationship between the various sections and have some knowledge of the importance of each. There can be no possible objection to the practical instruction of moulding and coremaking, though some may consider that casting is rather a dangerous occupation for boys. There is, of course, a certain amount of danger attached to the casting of metals, but that applies to any form of practical instruction, and particularly to metal workshops where machinery is in continual motion. It is, however, not necessary that the boys should cast metal, certainly not at the outset, as, during their preliminary training, wax may be used, and it forms a profitable substitute for metal until the boys prove their capacity sufficient to warrant the casting of some metal, such as aluminium. Wax when molten is not in any way dangerous, and it can be carried by means of single or double shanks in a similar manner to that likely to be adopted when metal is to be poured. In many ways wax proves a good substitute, for there are contraction difficulties to consider, and the results are more apparent than with metal. Then the surface of the moulds must be carefully prepared to obtain a clean skin on the castings, as the molten wax tends to penetrate the sand forming the face of the mould.

Widening the scope of the practical instruction given in junior technical schools increases the variety of work and gives the boys a better opportunity of deciding the occupation most suitable for their individual talents, and, incidentally, the broader outlook will help them in whatever section they select. Only by bringing the boys into touch with various crafts, before they commence to serve an apprenticeship, can we hope to overcome the difficulty of putting square pegs into round holes. These schools are attended by an intelligent type of boy, and, if they are given reasonable facilities in their instruction, other sections, besides the drawing office and metal workshops, will have the advantage of obtaining suitable apprentices capable of becoming skilled craftsmen.

Institution of British Foundrymen.

SHEFFIELD BRANCH.

Discussion on Dr. Desch's Paper on "The Fluidity of Molten Metals."

DR. W. H. HATFIELD, in opening the discussion, said he thought the lecture was typical of that real assistance which they as an Institution could expect from the University. Dr. Desch had dealt with a problem of the greatest practical importance in a delightful and scientific manner. Of course, as he had pointed out, they in Sheffield were essentially interested either in the fluidity of steel or in the fluidity of cast irons, and those metals lent themselves somewhat indifferently to the quantitative methods of investigation as described by Dr. Desch. The Japanese method was a very interesting one, but of a distinctly practical nature. The other method, with certain very considerable refinements, might be made applicable to cast metals. But turning from that side, he suggested that there was, amongst observant foundry people, more information concerning the true viscosity or mobility of molten iron and the influence of the varying elements on iron than had been available to the Professor. The published quantitative data bearing on this subject really was very scanty. We lived in an age of applied science, but the viscosity of liquid metals was only one of those regions where quantitative evidence was strangely lacking. There was not a single physical constant of the metals which had really been put on to a satisfactory basis by intensive research in the way that it should be, particularly now, when so much money was being spent on research. It could only be hoped that those vast sums were being diverted into channels where they would be of real use—which he very much questioned.

Cupola Capable of Superheating.

Viscosity, temperature and composition were the essential factors in steel and iron works, and he should like to assure the lecturer that he personally, and a number of his friends, did not feel that absence of real knowledge on this subject which would be apparent from what they had heard that evening. He was not in any sense deprecating what the lecturer had said, but, to take cupola practice, he was afraid the lecturer had rather left in the minds of his hearers the feeling that the cupola was somewhat ineffective in providing the superheat required for the running of castings. Now such was not the case. It was within his experience, and the experience of a number of practical foundrymen, that they might melt white iron in the cupola and get all the required degree of superheat. Similar conditions exist for grey, hematite, and phosphoric irons. The only point on which he was in real disagreement with the lecturer was that he could not follow him with his equilibrium diagram in his explanation of the variable behaviour of grey iron as against white iron in the cupola. When they heated an iron to a certain temperature it rapidly attained equilibrium for that temperature. It was within the experience of many of those who were interested in the case-hardening process—the cementation process, that if they heated wrought iron up to 1,137 deg. C., which was the eutectic point, it rapidly attained equilibrium as regarded composition in contact with the carbon, and very soon attained 4.3 per cent. of carbon, which was the eutectic, and melted. He suggested to the Professor that in a cupola the grey iron very rapidly indeed melted, owing to the fact that the response to the conditions of temperature and composition were such that equilibrium for that temperature was immediately reached—reached at the velocity of other chemical and physical reactions, with which they were familiar. Therefore that disability was removed. It was quite clear, then, that the explanation, which he understood was Mr. Riddel's, was an unsound one, and was untenable.

The Effect of Silicon on Viscosity

The lecturer had outlined the influence of silicon, and asked whether there might not be a direct influence in decreasing the viscosity of the metal. He could assure Dr. Desch that the effect of silicon was to increase the viscosity. If the very valuable work done by Wüst and Petersen* was studied, it would be found that the increase of silicon to the iron-carbon system decreased the solubility of carbon in iron. To take a foundry iron containing 3 per cent. of silicon, the eutectic for that series contained something like 3.5 per cent. of carbon, as against 4.3 per cent. for the simple iron-carbon eutectic, and therefore in practice it would be found that silicon decreased the viscosity by reducing the carbon content of the eutectic, and incidentally increasing its freezing point from 1,138 to 1,185 deg. C. It was a somewhat subtle point, but what he was saying was completely established by the fact, well known to many foundry people, that if they wished to make the finest castings they purchased the Swedish white iron which had the eutectic of the iron-carbon series, containing something like 4.2 per cent. of carbon, and it was owing to that very high carbon content of the Swedish white iron that such things as belt fasteners were cast with the greatest ease. In foundry irons one went up to 2.25, and even 3 per cent. of silicon, and those foundry irons had really a higher melting point than the Swedish white irons. Turning to the white iron series, it was clear to all of them that if they used too much scrap in the cupola they got a sluggish iron. The explanation was quite simple, on the hypothesis put forward by Professor Desch. It was a reduction in the carbon content, and instead of taking the eutectic alloy they were dealing with an alloy which was nearer to the steels. It was quite clear to him that if they had a sufficient degree of superheat, and if their composition was suitably controlled, as regarded cast iron they need have no worry concerning its fluidity, and he ventured to suggest that it was worth the while of the foundry industry to look into the matter from this point of view. There was much data and much knowledge available in the foundries, and if they would go forward and place in the lecturer's hands that large mass of practical experience which they possessed, he was quite sure Dr. Desch would correlate it with known physical laws, and so build up a fund of knowledge which would be invaluable to all of them in their foundry practice.

Oxides in Steel Castings.

As regarded steel castings, viscosity was purely a function of temperature and composition. They all knew, if the carbon was slightly increased in the steel, what a great difference it made to the running of the material. In passing, Dr. Desch had referred to the dissolved oxide. He (the speaker) must lay it down, as a result of long experience and much investigation, that in a Sheffield steel foundry, at any rate, *oxide of iron should not occur*. Oxide of silicon might, oxide of aluminium might, but oxide of iron did not remain in a properly made steel casting.

Fluidity of Electric Steels.

MR. F. DARLEY asked whether Professor Desch could give any information with regard to the fluidity of steel from the electric furnace. Recently, he had experienced a lot of trouble with "blobs" on the bottom side of the castings, furthest away from the runner, which gave him the idea that it was on account of the steel not being fluid. The steel of which he was speaking was about 0.2 carbon, 0.17 silicon, 0.015 phosphorus and 0.4 per cent. manganese. If they increased the silicon, say, to 0.3 or 0.4 per cent., the manganese to about 0.7 to 0.8 per cent., and the phosphorus to not exceeding 0.06 per cent., would that have any effect on the fluidity of the steel? Would that have a tendency to overcome some of the difficulties of which he had spoken? He was speaking of steel from the electric furnace. They did not experience any trouble of that kind when they used the Stock furnace.

MR. J. SHAW said he was quite in accord with Dr. Hatfield with regard to cupola melting. He thought it was quite clear that they obtained fairly fluid metal from white iron, for malleable purposes at all events, but its "life" did not last

* Metallurgie, Vol. III., pp. 811–820.

very long. The metal set very much more quickly than grey iron, probably due to high phosphorus, but not necessarily so, because hematite could act similarly. As regarded actual data for fluidity, Dr. Desch had thrown out several hints to them, but personally he knew of no method except one similar to the long tapering strip that had been described. He thought that was fairly universal, both in this country and in America.

Divergent Views on the Presence of Oxides.

With regard to oxidation, he thought Dr. Hatfield was wrong. They had the positive opinions of equally prominent men, who were quite certain that there was oxide in steel.

Dr. Hatfield: What is the evidence?

Mr. Shaw said the evidence was this, that in certain definite laboratories that were set up for the purpose, oxide had been found. Pickard, in his Carnegie research, found oxidation in what he called a white iron, which was a perfectly grey iron.

Dr. Hatfield: There is not any evidence in existence to-day to show that there is oxygen combined with iron in cast iron.

Mr. Shaw: What about Pickard's research? Can you prove that it is not so? Are there any methods existing whereby it can be proved that there is not? I beg to differ with you. The two American papers that were published recently state definitely that one cannot by any known method make a true determination of oxygen in iron.

Dr. Hatfield: This is a subject open to direct research, research which we have conducted, and I suggest other people should conduct it. Then, instead of talking about it, we should have evidence. I have evidence, and am quite satisfied.

Mr. Shaw: I can only repeat that the bulk of evidence given by those who are equally qualified and who have conducted research work is against you.

The Importance of Specific Gravity.

Mr. J. R. Hyde said there was much that they all wished to know about fluidity. They were trying to find the basic trouble. Some said it was oxygen; others ascribed it to absence of silicon or phosphorus. After the able case that had been put for both sides, they still felt that they wanted some accurate research. Dr. Hatfield had referred in a theoretical way to the fact that the difference in the specific gravity of the metals, as tested by the Japanese research, would have some influence on the running capabilities. For instance, most of the metals had specific gravities of about 7½ to 9, and it was obvious that 12 in. of head for a metal of that gravity would give distinctly bigger pressure at the bottom than would be the case with aluminium, which was only about 2.6. He should like to ask whether the Japanese workers had made any research in which they had controlled that definite pressure at the bottom. Did they make any attempt to balance it? Every practical moulder knew that he must always take into consideration the amount of head in casting anything.

Moulders Relieved from Responsibilities.

Engineer Captain Moorshead said he had had experience of a large number of inquiries on defective castings. Prior to the war, naval construction was to a great extent held up by faulty castings. The whole of the steam run of the "Iron Duke," the ship he was building, was kept back for three or more months because of the non-delivery of the steel castings, of which many were failures. He hoped that, with the experience of the war, this difficulty had been overcome. From his point of view, all these inquiries always turned on the pattern-maker, the foundrymen, and the steel maker. Dr. Desch had been a good friend to the foundryman, because he had definitely established that it had nothing to do with them, but was purely a question of the steel maker. If the latter maintained the proper superheat, then they would get the proper steel and the proper casting. He foresaw that in all future inquiries the foundrymen would say, "We are all right, we have done our job; it is the steel maker who is wrong, and if you don't set him right, and go in for research, and show him how to run the material and get the proper temperature there, until then we cannot do any better." He thought that from that point of view the lecturer had relieved the foundryman of a very great responsibility.

Lead in Admiralty Brasses.

The Japanese experiments were very interesting from a certain point of view, but it was a pity they were not elaborated, and that the workers did not carry out a series of experiments with varying degrees of superheat, so as to see what effect that had on viscosity and to arrive at something definite with regard to that. He noticed that in the bronzes viscosity was very much reduced when lead took part in the composition. Well, that had always been rather a sore point with the foundry with regard to Admiralty practice, and he thought the point arose in a Paper read before the Institute of Metals this year, in which the lecturer took exception to the conservative view of the engineering branch of the Admiralty, that they would not have any lead in brasses. He (the speaker) thought that the Engineer-in-Chief, who was in the chair, took the proper view when he said that they in the Service did not consider themselves specialists in that way, and they had such a broad field to enter that, when it came to a case of that sort, they had at their back the scientific world and many scientific advisers, and it was on scientific advice that no lead was allowed in Admiralty bronzes or brasses. Perhaps Professor Desch might throw some light on the great objection to lead. He had met with many failures, and he supposed that the high-strength bronze which was required in the Service for the high pressures of hydraulic work and for torpedo work resulted in many failures, and the suggestion that had always been put forward was that if a certain amount of lead was allowed then all would be well. Of course, those who put that suggestion forward knew that they were not allowed lead, so that that was one way of "dodging" the subject. He thought that if Professor Desch would give some definite lines on which research might be made, bearing in mind the practice that foundrymen had always in front of them, they might get some tangible result with regard to production.

Mr. T. Brown said he had repeatedly complained that the metals which they were getting at the present time from certain furnaces were not fluid enough. He had made experiments to see how far metals would run, but the Japanese method, which had been explained that night, had given him an idea for a better experiment than he had made himself. He was afraid that if they did they would find a very defective piece of steel where it had solidified and frozen at that particular angle. They might get a good piece at the end where it had been run in, but not where it stopped running. His experience was that, within a distance of 2 ft. to 2 ft. 6 in. of where a casting was run there was sound casting, but beyond that distance it was full of small holes. The casting itself was perfect, but the holes were revealed on machining. He contended that this was owing to the steel not being sufficiently fluid or the temperature not sufficiently high to travel that steel to its destination.

The Lecturer's Reply.

Dr. Desch, in reply, said he was naturally very much interested in Dr. Hatfield's remarks, and in fact he was particularly anxious, in giving the Paper, to get some expressions of opinion from those who had practical foundry experience, his own being mainly in non-ferrous practice. He quite agreed with Dr. Hatfield that there did exist amongst foundrymen a great deal of practical knowledge on this subject, but it had not found its way into print. He had searched through the volumes of the Proceedings of the Institution, and found very little indeed. The text-books and other publications, contained scarcely anything, and it would be a very good thing if foundrymen could put together some of the knowledge which they undoubtedly possessed on the practical difference between metals in regard to their fluidity. For his own part, he should be very grateful to receive any practical information of that kind, which one could make use of in a discussion of the subject. He had had to go on a very small amount of data. Dr. Hatfield expressed the hope that Universities

would be able to undertake work of that kind, and referred to the possibly unlimited funds for research. He (the speaker) was sorry to say that those funds were very strictly limited. The Universities just now were in a most difficult position. They were having the greatest possible difficulty in meeting their ordinary expenses, and every British University this year had a heavy deficit. An appeal was made by the Universities to the Government for additional help, and the Government had replied by cutting down the University grant for next year by £300,000.

Head Pressure Constant.

Reference had been made by Mr. Hyde to a source of error in the Japanese experiments owing to the varying amount of pressure in the head. He should say that although that was not thoroughly provided against, it was very nearly. The Japanese did not use equal volumes of the different metals, but equal weights—40 kilogrammes—which would give a practically constant head in each case. It was a huge head, very much larger than the amount of casting, so that, having equal weights, that meant that for aluminium there was a much bigger volume of metal in the head than there was for the iron, or the lead or tin.

Cupola Super-heating.

He was very interested to hear Dr. Hatfield's remarks about the cupola, and he (the speaker) might quite possibly be wrong in that. He had derived most of his information from Mr. Riddell's experiments, had talked the matter over frequently with him, had seen his results, and examined the products of casting in different ways, and it seemed to him that the explanation was on the whole fairly correct. He did not think, somehow, that equilibrium was reached quite as quickly as Dr. Hatfield suggested. But he was very interested to hear that it was possible to melt white iron in the cupola with a considerable amount of superheating. He should like to ask Dr. Hatfield whether that was in a cupola in which there was more than one row of tuyeres.

DR. HATFIELD: No, just the one row.

DR. DESCH: Then how do you get your superheat, because one would think that the whole of the metal was melted above the tuyere level?

DR. HATFIELD: No, it is everyday experience in all malleable foundries. Of course, in melting a white iron one might run with a fuel consumption of 3.5 cwts. per ton of iron melted, but where one is melting grey iron one may run on a fuel consumption of 1.75, that is half the fuel, and therefore there is a complete substantiation there of the argument which I placed before the Professor. These facts are well known to anyone in foundry practice, and may be confirmed.

DR. DESCH: I think that is the explanation—that when you are getting this white iron casting for your malleable purposes you use a high fuel consumption, and you therefore force it up to a higher temperature. That is the fact which I had overlooked. The superheat is obtained in that case, certainly. That does undoubtedly explain my difficulty. I was speaking of casting under ordinary conditions, and of foundries where no malleable iron is produced. The experience there is that if it is tried to run a white iron under the same conditions at which grey iron is cast it runs cold. But the two things are quite consistent, because Dr. Hatfield has now supplied the information which I did not possess. I am very interested, also, to hear his account of the influence of silicon in its actually increasing the viscosity, but I did not get an answer to the simple question of the case of steel, as to whether that 4 per cent. silicon steel is more or less fluid than a steel of the same carbon content. (Dr. Hatfield: Yes, it is more fluid.*)

More Opinions on Oxides in Steel and Iron.

Dr. Desch went on to say that when they came to the question of oxide in steel, then he must frankly say that he did not agree with Dr. Hatfield, and he had told him so before. He had on his side other authorities, such as Dr. McCance. He could not explain the behaviour of steel otherwise than by assuming a marked solubility for the oxide in the liquid steel. As to its being present in cast iron, that was still an open question, but he thought there was some evidence. There was in Greenland a mass of native iron of enormous size. It was formed below the surface of the earth by the reduction of a basalt containing large quantities of iron oxide by carbon. It was a mass of native cast steel, practically. In that steel there was a very remarkable eutectic. It was the eutectic of iron carbide and iron oxide—a very beautifully formed carbide-oxide eutectic. Undoubtedly this was due to the fact that it was produced below the surface of the earth and under pressure, so that the gases were not able to escape freely, and the equilibrium between oxide of iron and the two oxides of carbon was upset. But since a very large solubility was obtained—because this eutectic had been formed from liquid—under that pressure it seemed to him all the more likely that under atmospheric pressure they had a decided solubility.

Lack of Fluidity in Electric Steel Explained.

That also had a bearing on the question of Mr. Darley, who referred to the difference in fluidity between two steels of the same composition, one coming from the electric furnace and one from the Stock converter. Now he had been repeatedly told in foundries that this difference was regularly found when finding the temperatures of two steels with the optical pyrometer to be equal, taking one steel from the electric furnace and the other from a Tropenas converter. It was said that the converter steel maintained its "life" in the ladle longer than the electric steel. Supposing that to be the case—and he had been told by several experts that it was so—then his explanation was this: that the metal from a converter was not dead, that the reactions were not finished, that it contained dissolved oxide which was reacting with the dissolved silicon and manganese, and heat was continually being evolved; whilst the electric steel, on the other hand, was dead, and its reactions had finished. There was an internal source of heat in the converter steel, which was not present in the electric steel. That was the explanation he put forward. It was purely hypothetical. As he had said, they had not the data for the direct influence of these elements on the fluidity. So far as altering the melting point by bringing it down, of course there was an effect, but the relatively small changes suggested would not alter that very greatly.

The Lead in Brass Query.

Captain Moorshead had asked a question about the effect of lead on bronzes and brasses. Since he knew that in Sheffield the non-ferrous foundry industry was a comparatively small one, he made very little reference to bronze or brass casting, but of course it was well known that the fluidity of bronze or brass was very greatly increased by the presence of lead. The Japanese artistic bronzes always contained a very high percentage of lead. The statuary bronzes made by European firms contained zinc and lead in addition to tin, so as to increase the fluidity. This gave a metal which flowed readily into the mould, and took a quite sharp impression. For artistic work, they undoubtedly wanted a high percentage of lead. But it did not follow that they wanted lead in Admiralty bronze, and he must say that, having gone into that question a good deal, he was of opinion that the Admiralty was quite right in maintaining its limit to the lead-content in bronze. The experiments which had been published lately certainly showed that an inferior tin-bronze was improved by the addition of lead, by which they could get sounder castings, and could send up the tensile strength quite considerably. But they would not increase the tensile strength that they could get in a good tin-bronze, and a few of the firms that made Admiralty gun-metal, and took care that it was not overheated or oxidised, and also took great care about the scrap that they put in, got much better results than any of those firms that added lead. All that the lead did was to improve the soundness and remove oxide from an inferior bronze, but as soon as they had a good Admiralty gun-metal the quality was lowered at once by any addition of

* See Guertler and Tammann Zeitschrift für anorg Chemie, vol. xlvii., p. 163.

lead. Of course, for certain purposes, they wanted lead there for ease of machining, but the Admiralty put up with the greater difficulty of machining for the sake of higher quality of metal.

Blowholes.

The question that was asked in regard to the presence of the little blowholes was a little difficult to answer without looking carefully into the castings. The blowholes might be due to excess of dissolved gases or to imperfect fluidity, both of which were factors contributing to the porosity of castings. He had not made any reference to the influence of dissolved gases, which he thought was a question that needed a good deal of attention. The fluidity of a liquid was quite considerably altered by the presence of dissolved gases, and to what extent it was altered, or in which direction, was a matter for research in each case. They could not predict it: it required a definite amount of research to find how far the fluidity of a metal was influenced by these dissolved gases. It was quite possible that some of the differences which had been observed between electric steels and crucible steels, for example, might depend on differences in the quantity of dissolved gas, but at present the amount of research that had been done on this subject was altogether inadequate.

THE BRANCH-PRESIDENT, in expressing the hearty thanks of the meeting to Dr. Desch, emphasised what had already been said on the importance of collecting the practical information on these subjects that was in the possession of foundrymen, and bringing it forward.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

I.B.F. Propaganda

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I happen to have seen the reports in the daily Press of some of the annual dinners of the Branches of the Institution. In most cases the toast list has been so arranged that the well-being of the locality takes preference, as this is, of course, the best "copy" for the local Press.

Now, sir, I submit that one of the most important functions of these annual dinners is to let the world know what the Institution is doing. One method of accomplishing this is to place the toast of the Institution early on the list, then the local Press is infinitely more likely to give the Institution the prominence it undoubtedly deserves.

—Yours, etc., "INTERESTED."

Keighley Laboratories, Limited.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Will you permit us to congratulate Messrs. Keighley Laboratories, Limited, on their broad-minded policy of giving publicity to their most interesting research work.

It would be interesting to know what advantage is gained by allowing the molten metal to remain in the well of the cupola until sufficient quantity has been melted to ensure thorough mixture.

It is generally admitted that the first metal to come down is poor, which would seem to be largely due to the fact that it absorbs sulphur from the coke bed, and therefore suffers from these impurities.

It is also reasonable to suggest that the metal lying in the well of the cupola will not get hotter; it may even be cooler than if allowed to run from the cupola into a mixing ladle.

It would also be interesting to know the class of scrap referred to in the analysis given. Was it good quality machinery scrap, and whether heavy or light?

Foundries as a whole must suffer from rule of thumb methods still existing in their practice, especially so in that the scrap metal available is obviously and of necessity of poor quality.

As it will take many years for foundries to use up bad scrap, it is of vital importance that the trade, as a trade, should know how to counteract the bad effects of poor scrap.—Yours, etc.,

SAML. DENISON & SON, LIMITED,
S. L. BROWN.

Hunslet Foundry, Moor Road, Leeds.

Sketching and Photographing Jobs.

By J. DRINKWATER.

There is no more valuable habit to the craftsman, whether he be patternmaker, moulder or fitter, than that of keeping a notebook always at hand in which to jot down out-of-the-ordinary experience, useful hints, etc. The best memory plays one tricks, and knowledge is not knowledge if it cannot be quickly called upon. But if the notebook is valuable, what is almost as valuable is to have what we may term a pictorial representation of the job or device described. It is generally agreed that even the roughest sketch will sometimes convey more than a long detailed description. It is surprising how few patternmakers sketch really well, and the number of moulders who do so is fewer still. The conditions in the foundry do not make sketching an easy matter.

The pencil is one of the most useful tools, and the craftsman is well repaid when he learns to sketch well. The writer has found a knowledge of isometric projection of great value. One of the chief advantages of isometric and picture views is that they occupy little space, and are easily and quickly understood. Their usefulness is limited, of course, and if a dimensioned sketch is required it is much better to draw a front elevation, a plan, and an end elevation if necessary. A more complicated piece of work which requires sectional views to make it clear should not be drawn by the isometric method.

When the patternmaker in a textile shop is sent to a mill to get particulars of a job, or in a marine shop has to go to a vessel to lift sizes, a picture view is often very helpful. Even if he is able to get fairly accurate measurements, he has greater confidence if he can refer to what is virtually an arrangement drawing showing where the part which he is making will be fitted, and indicating necessary clearances of other pipes, gearing, etc. It is not necessary to keep such sketches in a notebook unless the job is a peculiar one and may be helpful in the future.

The moulder, unlike the patternmaker, does not need to make his own drawings. Sometimes, however, when a pattern is being made for an urgently-wanted job it is very useful if the moulder, as the pattern is being constructed, can go into the patternshop and make a rough sketch to assist him in looking out tackle. It is also occasionally helpful when making grids. The chief use of drawing to the moulder is, however, in sketching awkward parts for the mould or drawbacks. It may even be helpful in showing how venting difficulties have been overcome.

The camera is not a substitute for the sketch, but has its own place in patternshop and foundry. The writer has a large quantity of photographs taken both in patternshops and foundries, and has found them useful over and over again. For temporary use the camera is, of course, ruled out. It would not be possible, even if advisable, to use it in many places for which patterns have to be made, but it is invaluable for accurate representation of an intricate construction. For lecture purposes, series of progressive photographs are sometimes taken, the object being to show every step in the construction of the pattern or the mould. For loam work of all kinds such series of photographs are invaluable, but special facilities have to be obtained for taking them. It is usually possible, however, to photograph the finished pattern or mould without objection from any quarter. In some large works where there is an official photographer, the value of such photographs is being recognised, and a special background is prepared. The foreman has copies of the photographs, and when similar work comes along again he can refer to them. The workman can usually contrive to do his own photography in the dinner hour or before starting work in the morning. Foundries are not always well lighted, and it is not always possible to photograph with natural light.

Photographs of patterns are frequently of value when quoting for work. Pricing work is always difficult. To compute timber costs approximately considerable skill is required, besides the ability to visualise the finished job. With the photograph of a similar job before one, the work is greatly simplified and likely to be more accurate.

Open Sand Plate-moulding Simplified.*

By GEORGE BOYS.

When the proper precautions are observed the open sand method of moulding will produce castings that are perfectly satisfactory for many purposes. It may be adapted in many ways to meet specific conditions, a typical example being shown in the accompanying illustration.

A job was offered of making between 150 and 200 tons of floor plates 3 ft. 6 ins. long, 2 ft. wide and ¾-in. thick. The order specified that the plates should be flat, and of a uniform thickness, with rectangular corners and straight sides so that they would fit closely side by side. Apparently it was a good foundry job, but when the price the customer was prepared to pay was learnt it was decided that anyone would be better off without it although trade was quite slack at the time. However, before finally rejecting the contract the author submitted a proposition to his associates which promised a margin of profit, and upon further consideration it was decided to accept the job and go through with it.

Preparation of the Bed.

Two beds, similar to that shown in the illustration, were prepared. The straight-edges were in

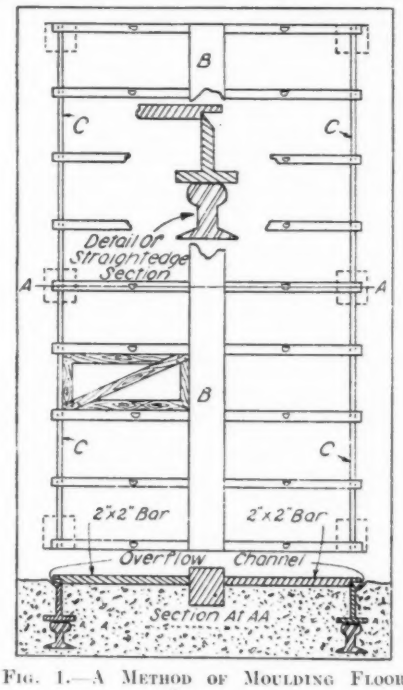

FIG. 1.—A METHOD OF MOULDING FLOOR PLATES.

two parts, and were butted together to make a continuous bed in each case. Briefly described, the idea was to supply a flat level sand bed on which the ends of the plates were confined by iron straight-edges and the spaces between the plates were taken up by pieces of 2-in. by 2-in. iron bars.

The square bars BB first were set up end to end and levelled, then the four iron straight-edges CCCC were set up as shown, 3 ft. 6 in. (shrink rule measurement) away from the centre bar and with the top edge about 2 ins. lower than the top edge of the centre bar. The straight-edges, bevel edged on the top and provided with three feet on the bottom were cast in open sand, bevel edge down. The bars D also were cast in open sand, and were employed as shown to form the sides of the plates. A thin iron strike provided with a jog ¾ in. at the outside end and 2¾ in. at the inside end was used to form the sand bed for the bottom surface of the plates. The feet on the straight-edges rested on short pieces of rails as shown in the sectional view. The rails allowed the straight-edges to *creep* during the expansion and contraction incident to the pouring operation, and still held them level and straight. A spirit level was tried on them occasionally to verify their accuracy, but they held their position without adjustment until the job was finished. Half a dozen iron runner boxes daubed with clay and provided with three handles were set at the ends of the plates to facilitate pouring. After the first six plates were poured the runner boxes were lifted and set on the following six moulds, and so on until all the plates were poured. The runner boxes then were set aside until the following day.

Unskilled Labour Employed.

A boy and a labourer made the plates every day. After the castings had been taken away, the sand between the straight-edges and the centre bar was wetted, dug up and turned over like a regular sand heap. It was then flattened and rapped down approximately the proper distance below the edges of the straight-edges. With the boy kneeling on the centre bar and the labourer kneeling outside the straight-edge, the iron strickle was pulled from end to end, leaving a flat bed on either side of the centre bar, and three-quarters of an inch lower than the top edge of the straight-edge.

A wooden templet or square frame was employed to locate the bars, D, which rested on the face of the sand bed, and served as retaining walls for the sides of the plates. The high bar in the centre prevented the metal slopping over from one plate to another at the inside end of the plate, while the bevel edge on the straight-edge allowed the surplus metal to flow over into a shallow trench at the pouring end as soon as the plate was filled to the correct thickness. This trench is indicated on the sectional view, and was designed to hold a small quantity of metal to prevent distortion of the straight-edge.

Pouring Conditions.

In pouring the plates the man on the end of a 250-lb. shank commenced slowly, filled the well of the runner box, then poured a good, steady stream until the mould was almost filled, at which point he slowed down and poured the last few pounds gently. The amount of iron taken in the ladle each trip was gauged by the foreman's eye. If the ladle contained a few pounds too much it flowed over the bevel edge of the straight-edge, and if the amount was a few pounds short the runner box was tilted and the contents of the well spilled into the mould.

These plates were all so nearly alike in thickness and weight that the average variation in weight in piles of 50 was only 11 lbs., and when they were placed in position on the floor of the ironworks the edges fitted together perfectly. A fair margin of profit was made on the job, and incidentally the scrap yard was cleaned up. Numerous boiler fronts have been made in this manner, including one 11 ft. sq., cast in four sections in a shop in New Orleans.

The most essential factor in producing satisfactory open sand castings is to pour the iron extremely hot. It does not matter how carefully the mould has been prepared if the iron is not exceedingly fluid it will be impossible to gauge the thickness of the casting with any degree of accuracy and the upper edges will be rounded instead of square.

In a modern foundry many things that formerly were disposed of in accordance with the judgment and trained faculties of the foreman, now are regulated mechanically. For instance if the open sand plates shown in the illustration were made in a modern foundry they would be laid out in a straight line under a mono-rail hoist. The small ladle for pouring the plates would be placed on a scale and filled with iron from a reservoir ladle until it registered the exact amount necessary to fill the mould. In this manner, and provided the face of the sand bed was uniform, every plate would be exactly alike in weight and thickness.

* Extracted from "The Foundry."

A New Non-Temper Brittle Steel.—In the course of a lecture last Saturday at Newcastle-on-Tyne before the Newcastle Foremen and Draughtsmen's Association, Mr. H. H. Ashdown, of Messrs. Armstrong, Whitworth's Openshaw Works at Manchester, intimated the discovery of a new non-temper brittle steel, termed "Vibrac" steel, which, it was claimed, overshadowed any of the modern alloy steels in its physical properties. It was stated that the steel had already been produced in great quantities, and under works conditions, and that under any normal treatment it was impossible to make it temper brittle.

Trade Talk.

THE HULL CORPORATION is promoting a Bill to enable it to construct a new bridge across the river.

GUEST, KEEN & NETTLEFOLDS, LIMITED, propose starting a second blast furnace at their Dowlais works very shortly.

THE STEELWORKS at Calderbank and those of the Scottish Iron & Steel Company at Northburn have been restarted.

THE KETTERING IRON & COAL COMPANY, LIMITED, restarted their furnaces last week. Work will also probably be re-started very soon at the Luffenham iron-ore pits.

OWING to the large number of applications for tickets for the Royal Metal Trades Pension Society annual ball, on February 24, it has been decided to engage the Grand Hall at the Hôtel Cecil.

THE MEDICAL COMMITTEE of the Industrial Welfare Society has been requested by many firms to suggest a suitable form for the use of medical officers when making their examination of employés.

FAIRBAIRN, LAWSON, COMBE, BARBOUR, LIMITED, have recently made an issue of £350,000 7½ per cent. notes at 94, redeemable at par from 1923. An issue of £150,000 £1 ordinary shares at par is also made.

THE annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, on March 8 and 9. The annual dinner will be held on March 8.

IT is feared, states a Melbourne report, that some well-known metal works at Newcastle (N.S.W.) will have to close down shortly, being unable to compete with imported goods. A stoppage would throw 400 men out of work.

THE FEDERATION OF BRITISH INDUSTRIES have forwarded a letter to the Postmaster-General complaining of the grave effects upon the industrial community of the present heavy charges for postal, telegraph, and telephone facilities.

THE SCOTTISH TUBE COMPANY, LIMITED, 34, Robertson Street, Glasgow, have removed their Liverpool office from 5, Strand Street, to Duke's Dock, where the company have opened a warehouse and carry a large stock of tubes and fittings.

DUE to unavoidable conditions the British Federation of Iron, Steel, Tinplate and Metal Merchants (Incorporated) is being wound up voluntarily. Mr. G. H. Ellis, 11, Queen Victoria Street, London, E.C.4, has been appointed liquidator.

THE DISPOSAL AND LIQUIDATION COMMISSION has decided that if no acceptable offer is received for H.M. Factory, Gretna, as a whole before March 31, the property will be partially dismantled, and the remainder offered for sale in separate lots.

MR. A. C. JONES has severed his connection with the firm of Armytage & Jones, Limited, of which he has been a director since its formation, and established himself in business as A. C. Jones & Company, iron, steel and timber merchants, 6, Bank Street, Sheffield.

DAMAGE estimated at £4,000 was caused by an explosion of gas in the power house of the heating and blast furnaces of Baldwin's new steel works at Port Talbot. The power house was wrecked, but the workmen escaped.

THE armour plate industry in Sheffield was not wholly suspended last year as during the period 2,911 tons of such material, valued at £582,542, was exported. It is fairly common knowledge that this armour was made by Vickers for the Japanese Government.

THOMAS PIGGOTT & COMPANY, LIMITED, Atlas Works, Spring Hill, Birmingham, have recently secured an order for one of their patent pressed-steel tanks, 140 ft. long by 48 ft. wide by 12 ft. deep. This sectional steel tank will be the largest yet built, and will have a capacity of 500,000 gallons.

THE graduates section of the North-East Coast Institution of Engineers and Shipbuilders met at the Neville Hall, Newcastle, last Thursday evening, when Mr. J. C. Arthur read his paper on "The Testing of Diesel Engines." The graduates visit the Carville Power Station, Wallsend, on February 18.

IN an interesting paper on "The Future of Cleveland Blastfurnace Practice," read recently by Mr. R. Sharp, of Messrs. Bell Brothers' Port Clarence Works, the lecturer said: "We are behind the times. If we are to regain our hold upon the world's iron markets we must get busy and reform our methods."

THE WHITEHAVEN HEMATITE IRON & STEEL COMPANY, LIMITED, intend to re-light the No. 1 furnace at the Cleator Moor Works at once. Following this comes the welcome news that three local iron-ore mines—Townhead (Egremont), High House (Frizington), and Parkside (Frizington)—are also restarting.

ON behalf of the Federation of British Industries, the Mansion House Association on Railway Canal Traffic and the Traders' Traffic Conference, a petition has been lodged against the applications of the new North-Western, Midland and West Scottish group of railways for powers to run road transport independently of the rail.

BOW, M'LACHLAN & COMPANY, LIMITED, Thistle Works, Abbotsinch, Paisley, have reached their jubilee, and the occasion was celebrated by the staff and foremen being entertained at dinner by Mr. William Bow. During the evening Mr. Bow was presented with a memento of the event, consisting of a silver punch bowl, suitably inscribed.

THE TURBINE FURNACE COMPANY, LIMITED, are supplying their furnaces to the Garswood Hall Collieries Company, Limited, Bryn, near Wigan; the Worsley Mesnes Collieries, Limited, Wigan; Ley's Malleable Castings Company, Limited, Vulcan Ironworks, Derby; W. Cooper & Goode, Limited, Birmingham; and Cochran & Company (Annan), Limited, Annan, Scotland.

RUSTON & HORNSBY, LIMITED, have secured a contract from the Government of South Africa for 38 heavy oil engines to be supplied to the South African Railways and Harbours Department for driving grain elevators and for electric lighting purposes in different parts of the country. The order, which is understood to be for approximately 2,500 brake-horse-power, was secured after very severe competition.

DORMAN, LONG & COMPANY, LIMITED, are adding another to their many undertakings, having acquired the three large hangars at Marske Aerodrome, near Redcar, which they intend converting into carriage and wagon-building works. The hangars are of immense size with span roofs and patent collapsible doors. They adjoin the North-Eastern Railway at a point mid-way between Redcar and Marske, from which they have siding connection.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to Mr. A. J. Colson, 25, Copthorne Road, Wolverhampton; J. Johnstone & Son, 212A, St. Vincent Street, Glasgow; A. J. Luck & Company, Limited, 37-38, Hatton Garden, London, E.C.1; Mr. G. F. A. Nettell, 58, Foxley Lane, Purley; Mr. G H. Jones, 74 and 99, Blackfriars Road, Salford, Manchester; London Smelting Company, Limited, 16, St. Helen's Place, London, E.C.3; and Mr. J. Pickup, 11, Part Street, Royton.

THE BARROW CORPORATION have received a letter from the Barrow Hematite Steel Company, Limited, stating that they view with the gravest alarm the expenditure being incurred on work which many believe to be unnecessary. They state they are unable to meet competition, even with reduced wages, and that unless some unforeseen change comes about in the near future their works, in common with other similar concerns, must close down indefinitely. The company cannot see how the municipal position can possibly be kept solvent unless drastic cuts are made in expenditure.

THE BRITISH CAST IRON RESEARCH ASSOCIATION, Central House, New Street, Birmingham, are endeavoring to get together a library of technical books and proceedings dealing with the cast iron foundry industry, such library being for the use of members of the industry. The Association members are practically entirely dependent upon voluntary gifts of books, etc., and the council are appealing to the industry for any spare books available. The early copies of the proceedings of the Institution of British Foundrymen, and copies of the proceedings of the Iron and Steel Institute previous to 1910, are particularly required.

American Foundrymen's Association:

The Annual Convention and Exhibition of the American Foundrymen's Association will be held in Rochester, New York, June 5 to 9. The reason for the change at this late date is embodied in the following statement, issued by the secretary of the American Foundrymen's Association:—

"This decision was reached following conferences on January 18 and 19 with Mayor Kohler, of Cleveland, at which time it was learned that, due to the incomplete condition of Public Hall, uncertainty as to when it would be open to the public, and the manner in which it would be operated, it would be impossible for them to give a lease for any specific date in 1922. And, further, that because of these conditions the present administration could not honour the agreements which the previous administration had entered into with the American Foundrymen's Association."

IRON AND STEEL MARKETS.

Pig-iron.

Movements in the various centres of the pig-iron trade during the past week have revealed little fresh in the position, consumptive demand on the whole continuing restricted in volume, conditions only partially counter-balanced by some renewal of activity in the export department. As far as the Midland situation is concerned, no general improvement has yet been noted, many of the smelting plants still remaining idle, with Derbyshire and Northamptonshire quotations stationary, if not exactly firm, attractive orders for extensive quantities usually extracting some price concessions from sellers. The conditions thus outlined in the Midlands areas also prevail to a similar extent in the West of Scotland, consumers reporting that whilst a fair volume of inquiries is in circulation very few result in actual business. Prices of Scottish foundry iron have also undergone a slight shading to the extent of 2s. 6d. per ton, which makes the No. 3 quality equally as cheap as similar brands of Cleveland. On Tees-side the outlook may be said to be brightening with makers of Cleveland well-sold for the remainder of the month. It is also reported that another shipment of iron is under contract for Germany, while Scotland is also buying on a small but steady scale. No. 1 quality still seems to be scarce, and it would appear that any further expansion in the demand would warrant the starting of one or two more furnaces. Prices are all very firm at the fixed minimums, which are :—No. 1 Cleveland foundry and silicious iron 95s., No. 3 Cleveland G.M.B. 90s., No. 4 foundry 87s. 6d., No. 4 forge 82s. 6d. Mottled and white is freely offered, and as there is no fixed price, competition plays its part in adjusting the value, which is round about 75s. per ton.

West Coast hematite makers have reduced their prices 10s. per ton, and Scotch is also lower, but even now East Coast hematite iron can be delivered to Sheffield cheaper than the West Coast product, and as fuel and ore prices are hardening, East Coast makers are not likely to cut prices further. As a matter of fact, some of them have fairly good order books and quote 95s. quite firmly for mixed numbers, and 97s. 6d. for No. 1, although it is still possible to buy at 2s. 6d. less than those figures.

Finished Iron.

Business generally in the finished iron departments continues quiet and uneventful, very few fresh transactions transpiring, while works, as a rule, are very indifferently situated as regards orders in hand, or, for the matter of that, in prospect in the immediate future. Price movements, however, continue in a downward direction, South Staffordshire makers of marked bars having reduced their quotations 30s. last week, thus bringing the basis down to £14 10s., and although as yet no official announcement has been issued regarding crown bars it is rumoured that £13 has been abandoned, and that members of the Association are free to sell at any price they can get. This may or may not be true, but in any case it is accepted that the £13 basis was withdrawn in view of the well-known fact that good quality crown bars have been sold at £12. Some of the makers declared prior to the reduction that they could not make crown iron profitably even at £13. Yorkshire crown iron bars have also been reduced from £13 to £12 per ton, and business in this material is so restricted that it is said that even this figure is being cut in some cases. The reduction, however, does not seem to have answered its purpose of stimulating trade.

Steel.

Nothing very encouraging with regard to the steel industry in general has transpired since last reported, and although some branches here and there are said to be better employed, work in most departments is still restricted, and in cases at a complete standstill. In the latter category may be included the crucible steel branches, whose outputs at one time constituted a most important proportion of Sheffield's staple products, while the compulsory closing down of the armament industries has had a further weakening effect upon the industry. The limited volume of business now moving is mainly concerned with Overseas orders, in which some improvement is noted as concerns India and the Far East, while a few firms are also busy completing the Russian orders for files previously mentioned in these reports. Among the principal sufferers from the present depression are the steel foundries, neither the ordinary nor the marine engineering branches placing orders at present for any appreciable quantities of castings, with the result that the heavy forges are also more or less idle. Competition is consequently keen for any orders in circulation, and some undercutting price movements in steel and finished products are said to be in active operation, dictated probably by the urgent necessity of realising stocks in hand to meet pressing obligations even at a substantial sacrifice. The re-opening of the Lanarkshire rolling mills after ten months' idleness is reported, but no improvement can be recorded in the local situation. The North East Coast steel works are all very badly situated for orders, and only intermittent work is possible at the best.

Tinplates.

Although a slightly better tone is observable of late in the tinplate market, the trade can hardly be described as in a satisfactory condition. Makers are badly in want of fresh orders, and are said to be accepting lower prices to secure business offering. Current quotations may be said to rule about as follows :—IC 14 x 20, 112 sheets, 108 lbs. cokes have been done at 18s. 9d. per box to 19s., with X substances at 3s. rise each cross. IC 28 x 20, 112 sheets, 216 lbs. cokes, present figures range from 37s. 9d. to 38s. 3d. per box, crosses 3s. basis extra.

Prices for wasters are quoted at :—CW 14 x 20, 18s. to 18s. 3d. per box ; CW 28 x 20, 35s. 9d. to 36s. per box ; CW 14 x 18¾, 18s. 6d. to 18s. 9d. per box ; CW 20 x 10, 23s. 3d. to 23s. 6d. per box. All prices are f.o.b. Wales and net cash.

Scrap.

The chief markets for scrap metal remain much as last reported, no great improvement in demand being noted as yet in the more important centres of consumption. In the Midlands, steel turnings are perhaps the only description for which there is any demand, and these are maintaining the price mentioned last week. Cast-iron scrap has not depreciated any further, and the prices last indicated are still being realised, although many of the users are of the opinion that when pig-iron again drops, cast-iron scrap will follow in its train.

Metals.

Copper.—Conditions in the market for standard copper have of late taken a steadier tendency, but home consumption still remains limited in volume, and buying has also been of a hand-to-mouth character. Selling pressure has, however, been relaxed to some extent, and business in Monday's opening market took a slightly brisker turn, March being done at £62 to £62 2s. 6d., closing steady with an improvement of 2s. 6d. in both positions. Refined descriptions were quiet, electrolytic closing at £67 to £69, and wire bars at £68 to £69. Closing prices :—Cash : Wednesday, £61 10s. ; Thursday, £61 7s. 6d. ; Friday, £61 10s. ; Monday, £61 12s. 6d. ; Tuesday, £61. Three months : Wednesday, £62 10s. ; Thursday, £62 5s. ; Friday, £62 10s. ; Monday, £62 12s. 6d. ; Tuesday, £61 17s. 6d.

Tin.—Business recently reported in the tin market has been considerably influenced by Eastern cable advices, giving sales of Straits at £156 10s. c.i.f., while later holders declined bids of £157s. 5s. On this side, however, business has continued steady, the week's opening market evidencing less selling pressure, and under good covering of March deliveries values marked a small advance. February was done at £153 15s. to £153 5s. ; March, £154 to £153, closing at £153 15s. ; May, £155 5s. to £154 15s., cash Straits selling at £155 5s., and English ingots 12s. 6d. higher at £152 17s. 6d. Shipments from Batavia during January comprised 1,084 tons of Banca, and 297 tons of Billiton. Stocks of tin in London have increased 46 tons on the week to 5,023 tons ; Liverpool stocks being 35 tons lighter at 1,904 tons, with Swansea unchanged at 10 tons. Closing prices :—Cash, Wednesday, £157 5s. ; Thursday, £154 5s. ; Friday, £152 15s. ; Monday, £153 2s. 6d. ; Tuesday, £152. Three months : Wednesday, £159 ; Thursday, £156 ; Friday, £154 15s. ; Monday, £155 2s. 6d. ; Tuesday, £153 15s

Spelter.—Movements in the spelter market are restricted by fears that large offerings of American metal may materialise, while the limited demand also contributes to the sensitive conditions existing, but fluctuations of values are confined within narrow compass, and quotations on the whole remain fairly steady. Closing prices :—Ordinary brands : Wednesday, £24 10s. ; Thursday, £24 12s. 6d. ; Friday, £24 10s. ; Monday, £24 10s. ; Tuesday, £24.

Lead.—There has been a fair demand for soft foreign pig, and both near and forward dates have closed with a slight advance, February and March at £21, and April and May at £20 17s. 6d. English is steady, and 5s. higher at £22 5s. English closing prices : Wednesday, £22 10s. ; Thursday, £22 10s. ; Friday, £22 ; Monday, £22 5s. ; Tuesday, £22.

Tenders Invited.

Antwerp, March 6.—H.M. Consul-General at Antwerp reports that the Municipal Authorities of that town are inviting tenders for the supply of a quantity of chains for the hydraulic cranes in use on the quays of the Scheldt and in the Antwerp docks.

Tenders to the "Bourgmestre d'Anvers, à l'Hôtel le ville d'Anvers. (Fee, 4,000 fcs.) Particulars by the Department of Overseas Trade (Room 49), 35, Old Queen Street, Westminster, London, S.W.1.

Ashton-under-Lyne, February 22.—For additional circulating water pipes and valves and exhaust steam pipe, for the Electricity Committee. The Borough Electrical Engineer, Wellington Road, Ashton-under-Lyne. (Fee £1 1s., returnable.)

Killoholm, February 28.—For the supplying and laying of about 2,135 lin. yds. of 4-in., 3-in., and 2-in. cast-iron water mains, for the Thornhill District Committee. Mr. C. W. Easton, 149, West George Street, Glasgow. (Fee £2 2s., returnable.)

Leeds, February 27.—Stores, for the Tramways and Highways Committee, viz.:—Bolts, nuts and washers; iron and steel; iron and steel castings; malleable iron castings. Mr. J. B. Hamilton, 1, Swinegate, Leeds.

Spalding, February 18.—For the construction of water mains, etc., for the Rural District Council. Mr. E. J. Silcock, 17, Victoria Street, Westminster, and 10, Park Road, Leeds. (Fee £5, returnable.)

Company News.

Greenwood & Batley, Limited.—Interim ordinary dividend, 2½ per cent.

Frodair Iron and Steel Company, Limited.—Ordinary dividend, 10 per cent. for year.

Lancashire & Yorkshire Wagon Company, Limited.—Dividend, 8s. per share for half-year.

Cooper & Smith, Limited.—Capital £12,500 in £1 shares. Electric motor manufacturers. Registered office: Station Road, Maldon, Essex.

Engineers' Supply Association (Norwich), Limited.—Capital £5,000 in £1 shares. Registered office: 17-18, Basinghall Street, E.C.2.

Evans & Ronald, Limited.—Capital £10,000. Engineers, etc. Directors: B. D. Bellamy, R. O. McGown (managing director), E. E. Lumley and A. J. Markin.

Hirst, Ibbetson & Taylor, Limited.—Capital £3,000 in 200 preference shares of £10, and 1,000 ordinary shares of £1. Founders, engineers, etc. Directors: J. Hirst, H. R. Taylor, W. H. Swain, and R. L. Ibbetson. Registered office: 37, Water Street, Manchester.

Mouldo, Limited.—Capital £1,000 in £1 shares. Manufacturers of foundry requisites. Registered office. 412, Royal Exchange, Manchester.

Scottish Wagon Company, Limited. — Revenue balance, £20,754; further dividend, making 9 per cent., less tax, for year; reserve, £4,000; carry forward, £878.

Sheffield Welders, Limited.—Capital £1,000. Welders and cutters of metals and other substances by electricity, oxy-acetylene or other similar process, etc. Directors: W. B. Hughes and F. Unwin. Registered office: 619, Carlisle Street East, Sheffield.

Staveley Coal and Iron Company, Limited.—No decision with regard to interim dividend.

Tredegar Iron & Coal Company, Limited. — Interim dividend, 5 per cent., free of tax, on "A" and "B" shares for half-year.

Wharfedale Tool Manufacturing Company, Limited.—Capital £2,000 in £1 shares (1,850 pref.). Permanent directors: W. I. Warburton, A. A. Hepworth and R. B. Warburton. Registered office: Main Street, Burley-in-Wharfedale.

National Gas Engine Company, Limited.—Net profit, £42,258; interim dividends, £28,500, 5 per cent. per annum on preference and 7½ per cent. per annum on ordinary; brought forward, £55,923; available, £69,681; final dividends, 5 per cent. per annum on preference, less tax, and 1s. per share on ordinary, £36,000; carried forward, £33,681.

Deaths.

MR. J. PETTIGREW, of 7, Victoria Street, Westminster, S.W.1, chairman of R. Gay & Company, Limited, a director of Robert Ingham Clark & Company, Limited, and chairman of the London Engineering Company, Limited, died recently at the age of 59 years.

MR. J. S. WALKER, M.I.C.E., the founder of Walker Brothers (Wigan), Limited, of which he was senior partner, died at his Southport residence, 15, Park Crescent, Southport, recently, in his 80th year. Mr. Walker, who served his apprenticeship with the Haigh Foundry, Wigan, commenced business at Wigan in 1868, being later joined by his two brothers, Mr. T. A. Walker, J.P., and Mr. E. R. Walker, J.P., and the well-known Pagefield Ironworks of the firm were founded in 1874, the business being converted into a limited liability company in 1903.

WE regret to announce that Sir George J. Carter, K.B.E., managing director of Cammell, Laird & Company, Limited, died at Birkenhead on February 9, aged 62. Sir George Carter served his apprenticeship at Portsmouth Dockyard, and entered the service of Sir W. G. Armstrong, Whitworth & Company, Limited, at Elswick in 1886. In 1894, when aged 34, he was appointed shipyard manager, and later was elected a director of the company. In 1912 he became managing-director of the great works of Cammell, Laird & Company, Limited, at Birkenhead, which cover 103 acres and employ 14,000 persons.

Personal.

THE LATE MR. WALTER MORRISON, J.P., a director of the Carlton Iron Company, Limited, left £2,000,000.

THE LATE MR. A. BARRETT, managing director of Bailey, Grundy & Barrett, Limited, engineers, left £7,909.

THE LATE MR. J. W. HARRISON, of Savile House, Wakefield, retired engineer and ironfounder, left £14,257.

THE LATE MR. W. O. PRICE, for 35 years secretary to the Uskside Engineering Company, left estate of the gross value of £3,845, with net personalty £3,670.

THE HON. SIR CHARLES PARSONS has been elected Master of the Shipwrights' Company, with Sir Charles Ellis, Lord Inchcape, Sir Kenneth Anderson, and Sir E. Tennyson d'Eyncourt as Wardens.

MR. E. A. WATSON, chief mechanical engineer of the Great Southern & Western Railway Company (Ireland), has resigned that position to become general manager and engineer-in-chief to Beyer, Peacock & Company, Limited.

MR. A. J. CRIDGE has resigned his position as manager of the transformer sales department of the Metropolitan-Vickers Electrical Company, Limited, to join the Brush Electrical Engineering Company, Limited, Loughborough.

Institute of Metals.

As previously announced, the annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on Wednesday and Thursday, March 8 and 9, 1922. The meeting will commence at 10.0 a.m. each day. On March 8 the annual dinner of the Institute will be held, and on March 9 there will be a visit to the Royal School of Mines.

The following communications are expected to be submitted among others:—(1) "Notes on the Corrosion and Protection of Condenser Tubes," by G. D. Bengough. (2) "The Internal Mechanism of Cold-Work and Recrystallisation in Cupro-Nickel," by Frank Adcock. (3) "The Effect of Impurities on Recrystallisation and Grain Growth," by the Research Staff of the General Electric Company (London). (4) "Further Studies in Season-Cracking and its Prevention. Condenser Tubes," by H. Moore and S. Beckinsale. (5) "The Rate of Combination of Copper and Phosphorus at Various Temperatures," by Professor C. A. Edwards and A. J. Murphy. (6) Note on "Some Cases of Failure in 'Aluminium' Alloys," by W. Rosenhain. (7) "A Further Study of the Alloys of Aluminium and Zinc," by D. Hanson and Marie L. V. Gayler.

The annual dinner of the Institute will be held at the Trocadero Restaurant, Piccadilly Circus, W.1, under the Chairmanship of the President, supported by the Vice-Presidents and Council.

THE ANNOUNCEMENT is made of a further addition to the already large number of iron foundries in the Falkirk district. Premises adjoining the Forth and Clyde Canal, on a site formerly used for a similar purpose, have been secured by a number of gentlemen, who are to carry on business as general ironfounders and engineers under the style of the Dundas Iron Company. Building operations are being pushed forward, and it is expected that the company will soon be in a position to commence manufacturing.